Number 36 Series 1926

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
In Cooperation with the University of Nebraska State Soil Survey
Department of the Conservation and Survey Division

SOIL SURVEY
OF
CUSTER COUNTY, NEBRASKA

F. A. HAYES, in Charge, and M. H. LAYTON, United States Department of Agriculture, and E. A. NIESCHMIDT, C. H. HAYES
A. N. HUDDLESTON, and S. S. DIEDRICHS
Nebraska Soil Survey

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This number is the last Soil Survey Report for the Year 1926.

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By F. A. HAYES, in Charge, and M. H. LAYTON, U. S. Department of Agriculture, and E. A. NIESCHMIDT, C. H. HAYES, A. N. HUDDLESTON, and S. S. DIEDRICHS, Nebraska Soil Survey

COUNTY SURVEYED

Custer County is in the central part of Nebraska. Broken Bow, the county seat, is near the geographical center of the State. The county is rectangular, measuring 54 miles from east to west and 48 miles from north to south. It has an area of 2,588 square miles or 1,656,320 acres.

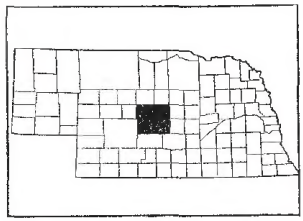

FIGURE 1.—Sketch map showing location of Custer County, Nebr.

The general physiography is that of an upland plain, ranging from almost level to steeply rolling or hilly. The plain is traversed by numerous lower-lying strips of flat alluvial lands and is modified in the northwest corner of the county by a large area of sand hills. Stream erosion and wind action have produced considerable relief. The greater part of the county lies in an area where the upland plain has been thoroughly dissected. It is now hilly. That part of the county not lying in the dissected plain consists of sand hills.

The comparatively level areas are not extensive. They occupy the highest positions in the county and occur principally near the center of the divides where the original constructional plain has escaped destructive erosion. Such areas are locally known as table-lands. The largest of these are in the southwestern part of the county on the broad divide between South Loup and Platte Rivers. Another large area occupies a part of the divide between South Loup River and the headwaters of Mud Creek in the west-central part of the county. Other small remnants of the table-land occur chiefly on the main divides, both north and south of Mud Creek, in the central and east-central parts of the county. The table-land areas are very gently undulating or almost flat and are modified in places by small sinks or depressions.

The sand-hill area occupies several townships in the northwestern corner of the county and a small isolated area west of Broken Bow in the central part. Throughout this division, wind has been the controlling element in the formation of surface features, and here the land ranges from gently undulating to hilly. Over the greater part of this area the loose incoherent sand has been blown into dunes, ranging in height from 30 to 70 feet, which give the region a decidedly hilly appearance. Around the margins of the hilly areas

are lower-lying narrow valleylike depressions with flat or hummocky surfaces.

The alluvial lands, including the terraces and flood plains along streams, comprise about 10 per cent of the total area of Custer County. The largest developments are along Middle and South Loup Rivers, Mud Creek, Wood River, and Clear Creek where they occur as continuous strips ranging in width from one-half mile to about 3 miles.

Custer County, with the exception of a small area in the southwest corner, is drained by the three Loup Rivers and their tributaries. These streams flow in parallel courses in a general southeasterly direction. The surface run-off in the southern and southwestern parts is carried to Platte River by Wood River and numerous small creeks. The greater part of the county is thoroughly drained, and over large areas the surface run-off is excessive and erosion is severe.

Well water of excellent quality is readily obtained in all parts of the county. Most of the upland wells throughout the eroded loess plains range in depth from 100 to 400 feet, extending to a sand sheet which underlies the loess, but in the sand hills and throughout the alluvial lands an adequate water supply is obtained at a depth ranging from 20 to 100 feet.

Native broad-leaved timber, consisting chiefly of willow, boxelder, elm, ash, and cottonwood, grows in narrow belts along most of the larger drainage ways. Dense growths of scrub cedar occur in many of the canyons throughout the northern part of the county. This timber is not of merchantable size but is of value for firewood and posts.

The first permanent settlements in Custer County were made in 1873 and 1874. Within the next few years, most of the land was included in homesteads. The early settlers were mostly American born but were of many nationalities. In 1877, the county was established with its present boundaries from a part of Kountz County. The population increased from 2,211 in 1880 to 26,407 in 1920. The average density of the rural population was 9.2 persons to the square mile in 1920. The rural population is densest in the larger stream valleys, on the level table-land areas, and in the vicinity of towns. The sand-hill area and the rougher parts of the eroded loess plain are sparsely settled. Broken Bow, the county seat and only city, had 2,567 inhabitants in 1920. This city is the main distributing center and affords a good market for much of the surplus farm products. Towns and villages conveniently located throughout the county afford local markets for farm implements, supplies, and produce.

The railroad facilities of Custer County are fair. The main line of the Chicago, Burlington & Quincy Railroad from Omaha, Nebr., to Billings, Mont., crosses the county in a southeast-northwest direction. A branch of the same system extends from Central City, Merrick County, through Comstock, terminating at Sargent. A branch of the Union Pacific system from Kearney to Stapleton crosses the southwestern corner. These railroads make good connections

with outside points. Many farms are from 12 to 15 miles distant from shipping points.

The public-road system is well developed except in the rougher and more sandy parts of the county where construction and maintenance are expensive. State and Federal aid highways cross the county in several directions. They are surfaced with gravel where necessary, are kept well graded, and are dragged after each rain. Throughout the more level areas roads follow section or land lines, but in the severely eroded areas of the loess plain and in the sand-hill region they conform to the topography. Telephones and rural mail routes reach all sections.

The surplus farm products, including grain, hay, cattle, and hogs, are marketed chiefly outside the county. Most of the wheat, hay, dairy products, and livestock are shipped to Omaha. The greater part of the grain is handled in local elevators where it may be sold at once or stored until a satisfactory price can be obtained. Flour mills at Mason City, Callaway, Arnold, Ansley, and Comstock use a part of the wheat produced in their respective localities.

CLIMATE

The climate of Custer County is well suited to the production of hay and grain crops and to the raising of livestock. The rainfall is moderate, the humidity relatively low, and the rate of evaporation rather high. The winters are fairly long and the summers rather warm. The cool weather of spring is usually accompanied by considerable precipitation. The fall season is long, with moderate temperature and occasional periods of rainy weather.

The greater part of the summer rainfall occurs during local thunderstorms. The mean annual precipitation, when normally distributed, is sufficient for successful farming without rigid adherence to dry-farming methods. In May and June periods of drought are very uncommon, in July the distribution of the rainfall is less favorable, and during August and September long periods of drought sometimes cause reduced yields of grain and hay. Total crop failures, however, are rare even in the poorer sections of the county, as most of the soils are retentive of moisture when properly managed and the small-grain crops are usually harvested before the dry weather occurs. The average annual snowfall of 25.2 inches affords protection for fall-sown small-grain crops.

The average date of the last killing frost is May 5 and that of the first is October 1. This gives an average frost-free season of 148 days, which is ample for the maturing of corn and all other crops commonly grown. Killing frosts have been recorded as late as May 27 and as early as September 12.

During most of the year the prevailing winds are from the northwest, but in June, July, and August they are mainly from the south and southeast. The proportion of clear sunshiny days is rather high.

Table 1, compiled from records of the Weather Bureau station at Broken Bow, gives the normal monthly, seasonal, and annual temperature and precipitation for Custer County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Broken Bow, Nebr.*

[Elevation, 2,477 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1912)	Total amount for the wettest year (1905)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	26.5	80	−27	0.60	0.12	0.00	4.4
January	24.1	78	−42	.34	.60	.93	3.0
February	25.2	78	−36	.53	.20	1.10	5.7
Winter	25.3	80	−42	1.47	.92	2.03	13.1
March	35.0	85	−19	.89	2.50	1.10	6.1
April	47.5	99	9	2.79	2.24	5.59	2.2
May	58.7	110	19	3.65	.57	5.73	.2
Spring	47.1	110	−19	7.33	5.31	12.42	8.5
June	68.9	104	33	3.96	1.30	8.26	.0
July	73.5	107	40	3.88	3.10	5.41	.0
August	71.8	109	36	3.14	1.30	.94	.0
Summer	71.4	109	33	10.98	5.70	14.61	.0
September	63.1	106	19	1.98	1.37	3.14	.0
October	49.8	97	6	1.56	1.27	1.13	1.0
November	37.1	80	−11	.73	.00	.71	2.6
Fall	50.0	106	−11	4.27	2.64	4.98	3.6
Year	48.2	110	−42	24.05	14.57	34.04	25.2

AGRICULTURE

Prior to 1869 the area now included in Custer County was occupied by the Indians who subsisted largely on wild game, fish, and fruit. The first white men to make use of the agricultural resources were cattlemen. A cattle ranch was established on Ash Creek in 1869–1870, and during the next 4 or 5 years agriculture consisted only of the grazing of cattle on the free open range, where a variety of nutritious grasses afforded good summer and fair winter grazing. Winter losses of cattle were heavy at times but usually the profits on the surviving animals were large. Grain farming began to replace open range ranching in 1873. The first homesteads were established by settlers from Grand Island, Nebr., who located in Middle Loup Valley, in Lees Park, and on Victoria Creek near the present site of New Helena. The early settlers located in the larger stream valleys where there was an abundance of fuel and water, but later settlement spread throughout the uplands. By 1890 most of the land was homesteaded and the cattlemen were forced either to move farther west or continue their operations within small fenced ranches in the rougher and more sandy parts of the county.

Sod corn was usually the first crop the settlers planted, and this, together with game and beef, formed the chief food. As conditions became more stable, wheat, oats, barley, rye, and garden vegetables were grown.

Early agricultural development was slow. The farmers were not familiar with local climatic and soil requirements, and farming methods were crude and wasteful. Much of the seed had been

brought from the more humid eastern States and the resulting crops were poorly adapted to the climate. Farm implements were crude, and the seed bed was usually poorly prepared. Exceptionally dry years beginning in 1887 and culminating in the severe droughts of 1890 and 1891 greatly checked agricultural development, and many of the settlers became so impoverished that they were forced to leave the county. In 1890 the population was considerably greater than in 1900. Since 1900, however, the population, owing to a better understanding of the climate and soil requirements, has gradually increased.

Under the present agricultural system the valley lands and the more nearly level table-land areas are held in comparatively small farms (from 160 to 320 acres) and are devoted to grain and alfalfa production, livestock feeding, and to a small extent to dairying. The rougher parts of the eroded loess plains and the sand hills are held in large tracts by livestock farmers and ranchers, many of whom cultivate only sufficient land to produce some grain and hay for feed. According to the last census reports the principal farm crops are corn, wild hay, wheat, alfalfa, oats, and rye, ranking in acreage in the order named.

Table 2, compiled from the reports of the Federal census, shows the trend of agriculture during the last 45 years.

TABLE 2.—*Acreage and production of the principal crops in Custer County, Nebr., in stated years*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	1,370	34,315	153,990	5,173,857	186,041	2,997,520
Oats	207	5,116	29,206	823,210	18,063	224,430
Wheat	1,006	10,780	25,742	419,234	166,426	974,340
Rye	19	373	2,910	43,332	11,279	64,140
Barley	89	1,464	1,152	26,327	5,630	48,410
Emmer and spelt						
Flaxseed		40	1,628	13,252	47	210
Potatoes		5,714	3,035	343,140	1,827	148,669
		Tons		*Tons*		*Tons*
Hay	2,066	3,477	60,376	75,367		
Tame hay					7,823	12,044
Wild hay					53,821	52,475
Coarse forage					1,413	2,522
	Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples			343	5	14,064	1,172
Cherries			430	5	6,781	105

Crop	1909		1919		1924	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	257,001	5,201,013	243,688	4,449,490	318,140	5,402,690
Oats	69,542	1,069,296	47,123	1,360,967	52,655	1,213,121
Wheat	51,573	744,832	98,042	1,024,518	27,206	478,104
Rye	2,349	22,798	30,603	290,090	10,218	126,368
Barley	5,826	82,267	8,217	167,847	4,220	62,104
Emmer and spelt	905	15,036	651	14,162		
Flaxseed	15	108			25	160
Potatoes	2,410	159,308	1,335	45,717	1,404	130,301
		Tons		*Tons*		*Tons*
Hay					207,234	185,164
Tame hay	51,122	77,116	67,334	98,334	92,614	
Wild hay	123,284	107,824	125,898	100,584	114,620	
Coarse forage	3,729	9,339	29,622	57,026		
	Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples	29,263	10,004	28,444	11,120	21,702	10,598
Cherries	19,453	1,708	17,554	6,242		

The type of farming practiced is fairly uniform throughout the county, although the relative importance of the various types differs with the sections. The proportion of land used for grazing and hay production is much greater throughout the sand hills, the rougher parts of the loessial uplands, and the poorly drained bottom lands than elsewhere. A larger proportion of the better-drained terrace soils and the more nearly level uplands is used for corn, wheat, and alfalfa.

According to the Federal census the value of all crops produced in Custer County in 1919 was $13,954,248. Of this total, $9,844,977 was for cereal crops alone. The total value of all domestic animals was $10,669,592. Dairy products were produced to the value of $811,157 and poultry and eggs to the value of $715,196.

Corn is by far the leading crop and on farms where it is not fed to livestock is the chief cash crop. The Nebraska State Department of Agriculture reported the average yield of corn in 1925 [1] to be about 24 bushels to the acre. This yield, however, is greatly exceeded on the firmer terrace and more nearly level upland soils where from 35 to 40 bushels are commonly obtained. On farms operated by owners most of the corn is fed to hogs, beef cattle, and work animals, but on tenant farms more is sold. A large acreage of corn is annually cut for fodder. The less progressive farmers grow corn on the same land several consecutive years, but much better yields are obtained if it is grown in rotation with small grains and alfalfa or sweetclover. In recent years some attention has been given to the selection of seed corn. Practically all the corn is of the dent varieties, principally Reid Yellow Dent and Silver King, though some Calico and Squaw corn, both flint varieties, are grown in the northwestern part of the county. This crop is grown in all but the more sandy, more poorly drained, and rougher parts of the county, but the well-drained silty terrace soils and the flat table-land areas are preferred.

Wheat ranks second in acreage among the grain crops. The area in winter wheat is usually about nine times that in the spring varieties, though the proportion varies greatly depending on the season. Winter wheat fluctuates less in yield than spring wheat and is less damaged by smut and rust. In 1925 the average yield of winter wheat was 13 bushels to the acre and of spring wheat 11 bushels. The acreage in wheat has decreased since the World War, as the market is less stable. Turkey and Kanred are the leading winter wheats and durum and club varieties are planted in the spring. The strains have been kept pure by the more progressive farmers, but on many tenant farms they have been mixed. The crop is planted throughout the more nearly level uplands and on the heavier-textured terrace soils. Wheat is a hard-land crop and is seldom grown on the more sandy soils.

In 1925 the yield of oats averaged 24 bushels to the acre. Fulghum is the principal variety sown. The grain is used largely as feed for work animals, and the straw is usually left in the field and livestock given access to the stacks. Some farmers obtain seed from other sections of the country, but most of them simply clean a sufficient quantity of the preceding crop for seed. Oats are grown

[1] All 1925 data are taken from the Nebraska Department of Agriculture statistics.

on all but the sandier, rougher, and more poorly drained soils of the county. They thrive on the soils producing the highest yields of wheat.

The acreage in rye varies greatly, depending on the market demand. In 1925 the average yield was 14 bushels to the acre. This crop is grown chiefly on the heavier upland and terrace soils but is also planted on the sandy terrace and Valentine soils. It is generally grown for the grain but to some extent for hay and pasture. It is more drought resistant than wheat or oats and flourishes on poorer soils.

In 1925 barley produced an average yield of 19 bushels to the acre. This crop is grown for feed in small patches on the uplands, terraces, and first bottoms. It does best on the moist bottom-land soils.

Potatoes are well adapted to the soils and climate of Custer County and it would seem that the potato-growing industry could be profitably extended. In 1925 the average acre yield was 64 bushels. Early Ohio is the leading variety, but some Irish Cobblers are grown in the more sandy parts of the county. Most of the potato crop is used at home, but a few farmers annually plant 30 or 40 acres of potatoes for sale in local markets.

Wild hay is still an important crop in Custer County, as large areas in the more sandy and rougher upland sections and most of the poorly drained bottom lands are unsuited to grain production. Much hay is grown on the coarser Valentine soils on account of their tendency to drift when the protective sod is destroyed. The highest yields of native hay are obtained on the poorly drained alluvial soils, but that cut from the uplands grows less rank, is of finer texture, and has a higher feeding value.

Among the tame-hay crops alfalfa ranks first in acreage. The area devoted to this crop has fluctuated only slightly during recent years. In 1925 the average acre yield was 1.8 tons. On the better terrace soils yields of 2 or 3 tons are common. Alfalfa does well on all the finer-textured well-drained soils but is poorly adapted to the more sandy soils which are unstable and generally low in lime. Three cuttings are usually obtained during a season. The crop is used as feed for cattle and hogs, very little being shipped out of the county. This is an excellent crop for building up depleted soils and for preventing erosion. It is often used in rotations but is not favored for short rotations, as most farmers prefer to keep the stand for several seasons before changing to other crops.

Among the minor feed crops, sorghum, millet, Sudan grass, sweetclover, and Kafir are the most important. In 1925 the average acre yield of sweetclover was 1.5 tons.

There are several small farm orchards in the county, but as the demand for fruit is not supplied it would seem that fruit production, especially on the terrace soils, could be profitably extended. Trees do not thrive so well on the uplands on account of the lack of moisture. Apples, cherries, peaches, and plums are the most important cultivated tree fruits, but only a few of the orchards receive sufficient care to insure maximum yields. Strawberries are grown commercially on a small scale by a few farmers in Middle Loup River Valley. Most of the berries are sold in the near-by towns. Of the wild fruits plums, chokecherries, and buffaloberries are com-

mon throughout the uplands and canyons, and some grapes grow along Middle Loup and South Loup Rivers.

Livestock and livestock products are an important source of revenue in Custer County. The Federal census reports 140,493 cattle in the county in 1925, with a total value of $4,220,681. Much of the land in the county is used as grazing land, and the raising of beef cattle is an important industry. There are only a few purebred herds, but many purebred bulls have been introduced in recent years in order to improve the grade stock. Grade Hereford and Shorthorn are the principal breeds, and Aberdeen Angus cattle are increasing in numbers. Most of the native cattle are shipped to Omaha as stockers or feeders after coming off the summer range, but large numbers are sold to local farmers for winter fattening. A few farmers annually ship in cattle for feeding, and many ranchers purchase livestock for summer grazing.

Only a few farms are devoted exclusively to dairying, although this industry is receiving increased attention. Dairying consists largely of the sale of surplus cream and butter in the near-by towns. There are a few purebred Holstein herds in the county. From four to eight milk cows, mainly of beef breeds, are kept on most farms.

Hog raising is an important branch of the livestock industry. The 1925 Federal census reports 157,077 hogs with a total value of $2,257,336 in the county. Most of the hogs are raised on the better hard-land soils where corn and alfalfa are abundant. Hog raising is of minor importance in the sand hills and throughout the rougher parts of the eroded loess plain, as these areas are better suited to cattle grazing than to grain production. All the hogs are of good breeding and there are several purebred herds in the county. Duroc-Jersey and both black and spotted Poland China are the leading breeds, but some Hampshires and Chester Whites are raised. At times heavy losses are caused by hog cholera. In recent years much attention has been given to vaccination and sanitary measures, and losses have been greatly reduced.

Sheep raising does not receive much attention, although there are several large flocks in the county, and a few ranches are devoted almost exclusively to sheep raising. Most of the animals are grazed in the rougher parts of the loess plains. The Federal census reported 5,312 sheep valued at $54,148 in the county in 1925. Hampshire and Shropshire are the leading breeds. Some farmers buy a carload or two of sheep in the fall, fatten them on corn and alfalfa, and ship them to the Omaha market when prices are satisfactory. The favorable climatic conditions and the abundance of feed would seem to warrant an extension of the sheep-raising industry. Large numbers could be fattened with little expense in the cornfields in the fall.

Most farmers raise two or three horse or mule colts each year, and often a team is sold. In the ranching sections there are a few large herds of horses. In recent years much improvement has been made in the draft stock through the introduction of purebred stallions. At present most of the animals are of heavy-draft types, principally Percheron, though many Belgian and Clydesdale horses are in the county. Mules are raised on many farms, as during recent years the demand for and price of these animals exceed those of horses.

In 1925, according to the Federal census, there were in Custer County 31,767 horses and 3,126 mules valued at $1,689,061 and $204,944, respectively.

Poultry and poultry products constitute an important source of farm income, and the poultry industry is receiving increased attention. Chickens are raised on every farm, and most farmers have large flocks. The local demand for poultry products is usually good. Rhode Island Red, Plymouth Rock, and White Leghorn are the leading breeds of chickens. Ducks, geese, turkeys, and guinea fowls are raised to a small extent. The Federal census reported 360,544 chickens valued at $255,986 in the county in 1925.

The adaptation of certain soils to particular crops is observed to some extent by the farmers, although the acreage devoted to the various crops is controlled largely by the selling price. However, the variation in yields is seldom sufficient to cause specialized farming in any part of the county except throughout the sand hills and the rougher parts of the eroded loess plains which are suited only for grazing and the production of hay. It is recognized that alfalfa is not suited to dune sand and the sandy Valentine soils on account of their low lime content and instability, but that it does exceptionally well on the highly calcareous and firmer soils of the Colby, Hall, and Holdrege series. Corn is known to do better than small grain on the sandy soils, but the highest yields are obtained on the Hall and Holdrege soils. Under average climatic conditions the hard lands are known to be better suited than sandy land to all grain and forage crops. The wet bottom lands are used for pasture and for hay production.

Systematic crop rotation is not practiced, although the better farmers have evolved more or less indefinite systems subject to numerous substitutions. On tenant farms the rotation is governed more by the demand and price of the grain products than by the requirements of the soil. Considerable alfalfa is grown, and when the sod of this crop is broken the land is commonly used for corn 2 years, oats 1 year, wheat 1 or 2 years, and then returned to corn. Corn is probably better adapted than small grain to recently broken alfalfa ground, on account of its deeper rooting system, but even this crop is subject to drought during the dry season as the alfalfa plant, which requires considerable moisture, leaves the ground in a rather dry condition. Many farmers plant corn or wheat on the same land three or four years in succession. Better yields are obtained, however, when a rotation system, including alfalfa or sweetclover, is used. Since sweetclover is increasing in favor, a rotation system which appears to have merit consists of corn 2 years, oats, rye, or barley 1 year, wheat 2 years, and sweetclover 3 years.

The farms as a rule are well improved, and most of the houses and barns are painted and kept in good repair. Some sod houses remain, but only a few of these are occupied as most farmers have constructed frame dwellings. The farms are fenced and cross fenced, mostly with barbed wire. In the rougher and more sandy sections, however, very few of the ranches are cross fenced, as the land is suitable only for grazing purposes and is simply inclosed with barbed-wire fence. The Nebraska Department of Agriculture for 1925 reports modern heating systems on 152 farms, modern lighting

systems on 183, and modern water systems on 275. According to the same report there are 186 tractors, 760 trucks, 117 grain threshers, and 6,306 automobiles on the farms. Modern labor-saving implements are in general use, and the more expensive farm machinery is sheltered. Tractors are used on the more level areas.

Commercial fertilizer is not used, or is not needed at present as most of the soils are new and in no immediate danger of becoming exhausted. Available barnyard manure is applied, but the supply is seldom sufficient to have much effect on crop yields. The land in the immediate vicinity of the barnyards, especially on the tenant farms, usually receives the most manure.

Farm laborers are scarce, especially during harvest. Most laborers prefer to work on the farms nearest the towns. Wages range from $35 to $45 a month with board, room, and washing. Day laborers receive from $2 to $2.50 except during harvest when the average daily wage is about $4. Corn shuckers received from 5 to 8 cents a bushel in 1925. A few farmers hire help by the year in order to insure against lack of labor at critical periods.

The Federal census reports that 88.6 per cent of the land in the county was included in 3,882 farms in 1925. The average size of the farms was 383.8 acres. Most farms range in size from 320 to 640 acres, but there are numerous smaller holdings, and many large ranches contain more than 1,000 acres. Only a little more than half the farm land is improved.

Owners operated 52.7 per cent of the farms and tenants 46.9 per cent in 1925. The proportion of tenant-operated farms has gradually increased since the county was established. Share and cash rental systems, as well as a combination of the two, are practiced, but share rent is most prevalent. Under the share-rent system the tenant usually receives two-thirds of the grain and furnishes all seed, labor, and machinery. The pasture land is usually rented for cash, though on a few farms the tenant has the use of the pasture land without charge. Under the cash system the renter pays from $2 to $7 an acre for the use of the land, including the pasture. The higher price applies to the best terrace land that is favorably located with respect to towns. During the last few years very little of the land suited to grain production has been rented for cash.

The 1925 census reports the average assessed value of all land in farms in Custer County to be $30.01 an acre. The selling price of land ranges from about $15 to $175 an acre, depending on the soil, surface features, drainage, improvements, and location with respect to markets. The highest-priced land, regardless of quality, is in the vicinity of the larger towns. The lowest price applies to the poorest areas of dune sand and the most severely eroded parts of the loessial uplands suited only for cattle grazing.

SOILS

The soils of Custer County owe their characteristics to a greater diversity of soil-forming processes and materials than occur in most other counties of Nebraska. The climatic and vegetative environments which have given the soils their broader and more general characteristics are transitional between those of eastern and western Nebraska. In eastern Nebraska the average annual rainfall of about

30 inches and the average relative humidity of about 69 per cent during a long growing season have favored the growth and decay of a luxuriant tall-grass vegetation. The well-developed soils have accumulated large amounts of carbonaceous material in their surface horizons from the decaying prairie grasses and are consequently very dark grayish brown or black. Downward-percolating waters have removed the readily soluble salts from both surface soil and subsoil horizons, leaving these layers very low in lime. In western Nebraska the average annual rainfall is much lower, about 17 inches, the growing season is shorter, the vegetation is less luxuriant, and the relative humidity is 5 or 6 per cent lower than in the eastern part of the State, all these conditions being less favorable for rapid vegetative growth and decay. The soils, therefore, are grayish brown, light brown, or chestnut brown. As the low rainfall has been barely sufficient to leach the carbonates from the upper part of the weathered soil, they have accumulated at some point within the profile, in few places more than 2 or 3 feet beneath the surface, forming the layer of highest lime concentration, or the lime zone, which is characteristic of all normally developed soils in the western part of the State.

In Custer County the mean annual rainfall and the relative humidity are about midway between those of eastern and western Nebraska. The vegetation is less luxuriant than in the region farther east, the rainfall is lower, and the moisture entering the ground is not sufficient, in all places, to remove the carbonates from the entire soil but has carried them to a greater depth than in the soils of western Nebraska. The Custer County soils, therefore, bear the impress of both the western and eastern regions to greater or less extent. Characteristics common to the soils of western Nebraska may prevail in one group and those common to the soils of eastern Nebraska may dominate another.

Throughout the well-drained gently undulating or rolling areas where the parent materials have received no fresh, unweathered deposits, the soil-forming processes have been active for a long time and have advanced at a uniform rate. Conditions have favored undisturbed soil weathering and the accumulation of organic matter. The soils in these localities have adjusted themselves to the climatic and vegetative environment and will retain their present characteristics as long as the environment remains unchanged.

A vertical section or profile of the soil in such areas shows the three following main layers or horizons: A surface soil, a subsoil, and the parent material. The first two comprise the true soil. The surface soil, in later soil literature, is usually referred to as the A horizon, and the subsoil is known as the B horizon. The A horizon may be defined as the layer from which material has been removed and the B as the one to which material has been added. The transfer of material is the result of either mechanical or chemical action, usually both, and has been made possible by gravity and percolating waters. Mechanical action involves a transfer of the finer mineral particles and some organic matter from the surface horizon and their concentration in the subsoil, thereby producing a heavier material in the B horizon. Chemical transfer is usually through solution and reprecipitation. The soluble salts, chiefly calcium carbonate or lime, are dissolved from the surface horizon, carried into the sub-

soil, and there precipitated, giving the B horizon a larger lime content than the A horizon.

Each of the upper two horizons may contain one or more subhorizons or layers which show minor variations in texture, color, structure, consistence, chemical composition, and compaction. The third main layer is the parent geologic formation, to or from which there has been no noticeable mechanical or chemical transfer of material. In the early stages of soil development it probably extended to or near the surface and was the dominant factor in controlling soil characteristics. As weathering progressed deeper and deeper, however, its influence became less and less pronounced until the soils developed from it retained very few characteristics common to the parent material. In virgin or uncultivated areas the surface soil, or zone of extraction, consists of at least two and in most places of three, rather well developed layers. The upper, or A_1 horizon, is loose, structureless, dustlike material ranging in thickness from a mere film to about 2 inches and in texture from silt loam to fine sandy loam. The next 3 or 4 inches, the A_2 horizon, is similar to or only slightly heavier in texture than the layer above, but the structure is laminated or platy. The small plates are thin and fragile, and a lump of the material when dropped breaks into a very finely granular mass, the small groups or aggregates of which seldom exceed one-fourth inch in diameter. The third, or A_3 horizon, lies between average depths of 5 and 20 inches. It commonly contains a little more silt and clay and is slightly heavier than either of the layers above. There is no suggestion of lamination, but the material breaks into irregular-shaped granules or nutlike lumps ranging in diameter from one-sixteenth to about 1 inch. This layer may or may not have a rather imperfectly developed vertical or columnar appearance, but if it has, the columns are best developed in a dry cut where shrinkage has caused the material to break along the natural lines of weakness. The columns average about 4 inches in diameter and are characterized by numerous horizontal seams and cracks at irregular intervals. These three horizons are distinct and sharply defined. All are rich in black organic matter, especially the middle or laminated layer which is very dark grayish brown or almost black. The A_1 and A_3 horizons are grayish brown or dark grayish brown. All three layers have been leached of their more readily soluble salts and have also lost a part of the finer mineral particles originally present in the parent material.

The next two layers are layers of concentration and collectively comprise the subsoil, or B horizon. The upper, or B_1 layer, has received fine mineral particles, chiefly silt and clay, and may be called the zone of maximum compaction. It ranges in thickness from 6 to 18 inches and in most places lies below a depth of 2 feet, though in some places it may be much nearer the surface. It consists of moderately compact grayish-brown cloddy material in which the lumps average more than an inch in diameter. The imperfectly developed columnar arrangement present in places in the layer above is less characteristic of this horizon. The lower, or B_2 horizon, has received most of the soluble salts carried down in solution from the overlying layers. It ranges in thickness from 8 to 30 inches and consists of light grayish-brown structureless silty material differing little in texture or color from the parent material. This is the zone

of maximum carbonate accumulation or the lime zone. The carbonates have concentrated as numerous seams, splotches, and fine winding threads of white lime. The two subsoil layers are sharply defined. There may be slight differences in their compaction or concentration in different parts of the county, but in no place does the dominant characteristic of the one occur in the other, and their position in the soil profile is nowhere reversed.

The next layer is called the C horizon. It is the geologic formation from which the soils have developed on the more nearly level uplands and terraces and is seldom reached above a depth of 4 or 5 feet. It consists in most places of loose floury light-gray or almost white silt, known in the Nebraska surveys as loess. The material is highly calcareous throughout and contains numerous rust-brown spots below a depth of 50 or 60 inches. The lime occurs in finely divided form thoroughly mixed with the silt, and there are no spots of unusual concentration or segregation of the carbonates as in the lime zone. Moreover, there has been no accumulation or extraction of materials as in the layers above, and the formation remains uniform to great depths except where modified by sand.

Soils characterized by the profile described are grouped in the Holdrege series of the uplands and the Hall series of the well-drained terraces. Although the profiles of soils of these two series are uniform in most places, they may vary somewhat in different parts of the county or even within the same locality. One or more of the horizons may be poorly developed or absent or may be separated by thin layers of transitional material bearing some characteristics common to the horizons above and below. In general, the larger the sand content the fewer the horizons, or if all horizons are present and the sand content remains high one or more of them is very poorly developed. The horizons most commonly affected by sand are the lime zone, the zone of maximum compaction, and the laminated or platy layer.

The Tripp soils, which occur on loessial terraces in Custer County, have developed under conditions slightly less favorable for deep soil weathering and accumulation of organic matter than prevailed in the soils before mentioned. Their vegetative covering is less luxuriant and their characteristics are very similar to those prevailing in the soils of western Nebraska. The arrangement of the layers in the Tripp soils is very similar to that in the Holdrege and Hall soils, but the surface layers contain less organic matter and are consequently lighter in color, ranging from grayish brown to chestnut brown. In few places is the zone of lamination so well developed as in the Holdrege and Hall soils, and it may be entirely lacking, the loose structureless surface mulch resting directly on a faintly granular lower layer of the A horizon. The zone of maximum compaction is thinner and less pronounced than in the Holdrege and Hall soils; percolating waters have not carried the soluble salts to so great a depth as in those soils, and the lime zone, in most places, is within 4 feet of the surface. The parent material is directly beneath the lime zone.

The O'Neill and Sioux soils occupy the more sandy terraces of Custer County. These soils have very dark grayish-brown or black surface horizons, and well-drained, well-aerated, and well-oxidized subsoils. The weather resistant character of the sandy material

from which the soils are formed, however, has prevented the development of clearly-defined zones or layers such as occur in the finer-textured Hall, Holdrege, and Tripp soils. The subsoils are largely composed of incoherent and rather uniform mixtures of sand and gravel. Those of the Sioux soils have retained considerable lime, but the subsoils of the O'Neill soils have been leached of their carbonates.

The Scott soils have developed under more moisture than any of the other upland or terrace soils of the county. They occupy small depressions, locally known as "buffalo wallows" or lagoons, scattered throughout the more nearly level uplands and terraces where conditions have especially favored plant growth and decay. The surface soil, or A horizon, of these soils, although very dark, is a little thinner than those of the Holdrege or Hall soils because excessive downward percolation of the moisture has carried large quantities of fine mineral and organic materials into the subsoil. This translocation, together with poor drainage, has resulted in the formation of a slate-colored or almost black, compact, claypanlike B horizon which may range from 2 to 5 feet in thickness. In most of the areas occupied by these soils downward seepage has leached the soluble salts to depths below 6 or 8 feet. Throughout most of the depressions the claypan layer has become so dense as to prevent further seepage, and surplus moisture remains on the surface of the ground until removed by evaporation. The parent formation, a friable calcareous silt similar to that underlying the Holdrege and Hall soils, lies below a depth of 5 or 6 feet.

Throughout the remainder, and by far the greater part, of Custer County, the soils are either younger, more severely eroded, more resistant to weathering or less stable than the Holdrege, Hall, and Tripp soils and have not reached such an advanced stage of development. The soil-forming processes have not acted to their maximum capacity, as determined by the climate and vegetation of the region, and the soils, as a rule, are very poorly developed. For convenience in description such soils may be placed in three groups, depending on the factor or group of factors which have been instrumental in curtailing their development.

In the first group may be placed those soils in which full development has been prevented by erosion. It includes the members of the Colby series, which occur throughout the rougher areas of the uplands wherever erosion has greatly thinned or entirely removed the dark-colored surface layers of the Holdrege soils. Constant erosion has prevented the accumulation of much organic matter in the soil, and the rapid removal of the surface water from the slopes has not allowed leaching of the carbonates from the underlying layers faster than new material has been brought near the surface. The A horizon is thinner and lighter in color than that of the Holdrege and Hall soils. The Colby soils have neither a zone of compaction nor one of lime accumulation, but the grayish-brown surface soil rests directly on the light-colored parent loess. In many places erosion has entirely removed the organic matter, exposing the highly calcareous parent formation.

The second group includes those soils in which full development has been prevented by the instability of the parent geologic formation. With this group are placed dune sand and soils of the Valen-

tine, Anselmo, and Bridgeport series. All these soils either consist of or have been developed from accumulations of wind-blown or water-laid sand, which are of such recent origin or have been so continuously shifted about that they have accumulated very little organic matter. Dune sand is not a soil but is simply a geologic formation consisting of incoherent shifting sand. In the other members of this group the sand is a little more stable and the soil-weathering processes have made some progress, the degree depending largely on the purity of the sand deposit and its stability. In the Valentine soils the sand is very pure and is composed almost entirely of quartz. Any soluble carbonates which it may have contained were rapidly leached away. The resistance of the sand has prevented any layered or zonal development in the profile, such as usually occurs in finer-textured materials, and the only advancement toward full soil development is in the accumulation of small amounts of organic matter in the surface layer. In the Anselmo and Bridgeport soils the sandy parent material has become mixed with silt from the near-by loessial areas, and is therefore more stable and offers less resistance to weathering than that from which the Valentine soils have developed. The surface layers have accumulated a little more organic matter than in the Valentine soils, and the Anselmo soils especially have developed fairly distinct zones or layers in both surface soil and subsoil horizons. The Bridgeport soils are less mature, but the weathering processes have produced, in places, a rather imperfect zonal or layered profile arrangement, and for this reason they may be said to have reached a stage of development beyond that attained by the Valentine soils. The Anselmo soils have been leached of their carbonates, but the subsoils of the Bridgeport soils retain considerable lime.

The third group of poorly developed soils includes those in which full development has been prevented chiefly by poor drainage. This group includes the Gannett soils, which occupy basinlike depressions within the dune sand areas, and the Cass, Lamoure, and Sarpy soils of the first bottoms or flood plains. Imperfect drainage has favored rapid vegetative growth and decay, and all the poorly drained soils except those of the Sarpy series, which have weathered from the most recently deposited alluvial sediments, have developed dark-colored surface layers. The soil-forming processes, however, have not greatly influenced the material beneath the surface horizons, owing to the water-logged condition of the subsoil. Oxidation and aeration have been greatly retarded in the B horizon, and the surface soils in many places rest directly on the unweathered or only slightly weathered parent alluvial deposits. Owing to poor aeration, most of the imperfectly drained soils have gray or mottled gray and yellow subsoils stained with numerous rust-brown specks and splotches in many places.

On the basis of the composition and processes of accumulation of the parent materials from which the soils have developed, the soils of Custer County are divided into three groups, loessial, aeolian, and alluvial.

The thick smooth mantle of plains loess which once covered the entire county, with the possible exception of the extreme northwest corner, is an even-textured material composed largely of silt particles. It ranges in color from brownish yellow to yellow or almost

white and has a tendency to split into vertical planes producing perpendicular bluffs along watercourses, road cuts, and other places subject to erosion. Lime is abundant, and a small proportion of iron stains the material in many places. This thick loessial mantle has been more or less eroded in Custer County and in places has been entirely removed by stream action. The nearest approach to the original loess occurs in the northeastern part of the county where the land is extremely rough and dissected. Since deposition most of the loessial deposit has undergone marked changes. Owing to an accumulation of organic matter the surface soil has become very dark grayish brown or black in the less eroded areas. The dark color is strongest and continues to a greater depth in the depressions and on the broader and more nearly level divides. In depressions the subsoils are characterized by a decidedly compact layer between depths of 2 and 4 feet. In areas of steep relief, where the run-off is great and the leaching of organic matter is rapid, the surface material is lighter in color and the subsoil contains no zone of unusual compaction. The dark-colored loessial soils are grouped in the Holdrege and Scott series. The Holdrege soils have weathered under normal drainage conditions and have friable subsoils. The Scott soils occur only in depressions and are poorly drained. The severely dissected areas of loessial soils throughout which erosion has prevented the accumulation of much organic matter on the surface are classed in the Colby series.

In the northwestern part of the county the loessial material gives way to extensive deposits of sand, the greater part of which was originally released from the tertiary sandstone formations of western Nebraska and carried to its present position by wind and stream action. A part, however, was probably derived from a sand sheet which underlies much of the loessial mantle in Custer County. The sand from the two sources has been so mixed, reassorted, and shifted about that it is not possible to make a definite statement in regard to its origin in a given locality. In its unweathered condition it is light brown or yellowish gray and is composed largely of quartz particles. The soils which have weathered from it include dune sand and members of the Valentine, Gannett, and Anselmo series. Dune sand occurs in places where the wind has been most active and has heaped the sand into dunes ranging in height from 30 to 100 feet. The Gannett soils occupy depressions in the sand hills in which water accumulates during periods of high rainfall. In wet seasons some of the depressions become temporary marshes. In addition to producing the Valentine, Anselmo, and Gannett soils and dune sand, the wind-blown sandy deposits have greatly modified the physical and chemical characteristics of the adjoining loessial upland soils and of the lower-lying alluvial lands.

The alluvial material of Custer County is of recent deposition and occupies two topographic divisions, terraces or benches and first bottoms or flood plains.

The character of the sediments deposited by the streams depended largely on their source and on the degree of mixing and assorting to which they were subjected prior to final deposition. The smaller upland streams flowing through areas of loess carried only fine-textured silty material and their sediments were naturally uniformly

silty. That the same condition existed along all the rivers during the early stages of their development is shown by the uniformly fine texture of the few older terrace remnants along these streams. Subsequent intrenchment, however, of South Loup and Middle Loup Rivers into the sand sheet underlying the loess and the headward erosion of these streams into the sand-hill region to the west gave rise to coarse sandy sediments. The mixing and reassorting of the fine and coarse particles has produced materials ranging widely in texture. Where occurring on the well-drained terraces these materials have weathered into soils of the Hall, Tripp, Sioux, O'Neill, and Bridgeport series, and where lying within the first bottoms and subject to overflow, into soils of the Cass, Sarpy, and Lamoure series. The Hall, Tripp, and Lamoure soils have weathered from fine-textured silty deposits, and the Sioux, O'Neill, Bridgeport, Cass, and Sarpy soils are composed largely of coarse sandy materials. The material from which the Bridgeport soils have weathered is not entirely alluvial, a large part having reached its present position through colluvial action from the adjoining uplands. Most of the soils of this series, however, occupy terracelike positions and for this reason are included in the alluvial group.

Soils are grouped in a series on the basis of similarity in color, structure, and all other characteristics of the soil profile except texture of the surface soil. The series are further separated into soil types on the basis of texture or the relative proportion of the different-sized mineral particles composing the surface soil. In Custer County 32 soil types and 5 phases of types, representing 14 soil series, are mapped. Dune sand and river wash are miscellaneous materials not classed in any soil series.

In the following pages of this report the members of the different soil series are described in detail, and their relation to agriculture is discussed. Table 3 gives the acreage and proportionate extent of the various soils, and the accompanying map shows their distribution in the county.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Custer County, Nebr.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Holdrege silt loam	156,352	11.2	Hall silt loam	69,184	4.2
Colluvial phase	30,144		Hall very fine sandy loam	77,120	4.7
Holdrege very fine sandy loam	125,312	9.1	Hall fine sandy loam	24,896	1.5
Colluvial phase	25,280		Hall silty clay loam	5,312	.3
Holdrege fine sandy loam	11,968	.7	Tripp very fine sandy loam	5,632	.3
Colby silt loam	367,424	31.3	Sioux fine sandy loam	4,736	.3
Broken phase	151,488		Bridgeport fine sandy loam	4,096	.2
Colby very fine sandy loam	103,616	9.7	O'Neill loamy sand	8,256	.5
Broken phase	57,216		O'Neill fine sandy loam	2,240	.1
Colby fine sandy loam	36,608	3.6	O'Neill very fine sandy loam	832	.1
Broken phase	23,104		Cass fine sandy loam	5,376	.3
Colby loamy sand	14,976	.9	Cass very fine sandy loam	2,944	.2
Colby sand	8,192	.5	Cass loamy sand	12,352	.7
Anselmo very fine sandy loam	3,072	.2	Sarpy sand	6,720	.4
Anselmo fine sandy loam	13,504	.8	Sarpy gravelly sand	576	.1
Anselmo loamy sand	10,752	.6	Lamoure very fine sandy loam	448	.1
Valentine sand	86,528	5.2	River wash	128	.1
Valentine loamy sand	11,904	.7	Dune sand	174,976	10.6
Valentine fine sandy loam	6,912	.4			
Gannett loamy sand	448	.1	Total	1,656,320	
Scott silty clay loam	5,696	.3			

HOLDREGE SILT LOAM

The surface soil of Holdrege silt loam consists of three rather well-defined layers of friable uniform silt loam. The first layer is a dark grayish-brown loose structureless dustlike mulch from one-fourth to one-half inch thick. The next is much darker, being very dark grayish brown or almost black. It is 2 or 3 inches thick and has a laminated or platy structure similar to that in the corresponding layer of Holdrege very fine sandy loam. The third layer continues to a depth of 10 or 12 inches. It is similar to or only slightly lighter in color than the laminated zone but has an imperfectly developed granular or crumblike structure.

The upper subsoil layer consists of dark grayish-brown loose mellow silt loam extending to a depth ranging from 18 to 24 inches. It has an imperfectly developed columnar structure, the columns ranging from 5 to 10 inches in diameter. Horizontal cleavage at irregular intervals is common, and the columns break into imperfectly formed cubes from 4 to 6 inches in diameter. The lumps are practically structureless and are easily reduced to loose floury grayish-brown silt or silt loam. This layer is underlain by a 10-inch structureless layer of grayish-brown granular silt loam or silty clay which, although faintly compact, crushes easily between the fingers and thumb, even when dry. None of the layers described contains sufficient lime to effervesce with acid. The third subsoil layer, which ranges in thickness from 4 inches to more than 2 feet and lies between average depths of 30 and 40 inches, is the zone of maximum carbonate accumulation and consists of loose silty flourlike material ranging in color from grayish yellow to almost white and characterized by numerous specks, streaks, and splotches of white lime and a few small angular lime concretions. The lime content is sufficient to cause strong effervescence when acid is applied.

Beneath this layer is the parent material of light grayish-brown, grayish-yellow, or in places almost white, silt which is even looser and more flourlike than the material in the zone of carbonate accumulation. It is uniformly calcareous but contains no spots of unusual lime concentration or segregation. Rust-colored specks and seams may occur at a depth of 50 or 60 inches. The unweathered loess extends without any marked change to a great depth. The organic matter, so plentiful in the surface soil, decreases rapidly with depth and is scarcely noticeable below a depth of 30 inches except along cavities formed by grass roots, insects, or worms.

Holdrege silt loam is very uniform throughout Custer County. A few minor variations, however, are worthy of mention. Locally, on the shoulders of divides and the steeper slopes, erosion has greatly thinned and in places entirely removed the surface soil, exposing the light-colored underlying material. Such areas, where of sufficient size to warrant mapping, are included with the Colby soils, but the smaller patches are included with Holdrege silt loam. In a few places the upper subsoil horizon is very poorly developed or entirely lacking, and the dark-colored surface soil rests directly on the slightly compact second subsoil layer. The principal textural variation is toward very fine sandy loam. All the soils of the county have been more or less influenced by wind-blown sands, and a few

small patches of Holdrege very fine sandy loam were included in mapping. Narrow strips of alluvial and colluvial materials along the smaller drainage ways are also included.

Holdrege silt loam occurs in large and small tracts throughout the county except the northwestern part where the sandy deposits have modified the silty texture of all the loessial soils. Areas of Holdrege silt loam range from almost level to rolling, but most of them are undulating or gently rolling. The soil occurs chiefly on remnants of the original loess plain, which have escaped destructive erosion, and consequently occupies some of the highest positions in the county. Drainage is thorough, as even the flatter areas have sufficient slope to carry off surplus surface moisture, and the porous subsoil affords ample underdrainage. On a few of the steeper slopes around the margins of this soil surface run-off is excessive and erosion severe. In such localities areas of Colby soils are gradually encroaching on Holdrege silt loam.

Holdrege silt loam is probably as strong and fertile as any of the upland soils in the Mississippi Valley. Owing to the lower rainfall, however, crop yields here are usually much lower than those obtained in States farther east. Corn, wheat, alfalfa, and oats are the leading crops, and most farmers grow small patches of rye, barley, sweetclover, millet, or Sudan grass for feed. In seasons of ample precipitation corn and alfalfa yield about twice as much as in normal years. The native vegetation included a dense growth of grama and buffalo grasses, but practically all the land has been broken for crop production and only small patches of virgin sod remain along the highways or within small pastures. Cattle raising is not practiced extensively, as the land is too valuable to be used for grazing purposes. Many farmers, however, have specialized in the fattening of livestock. Most of the animals are native Herefords or Shorthorns, though a few farmers annually ship in livestock for winter feeding. The cattle are fed corn and alfalfa from 60 to 90 days and shipped to the Omaha market. Hogs are raised on every farm, and a few farmers have large herds.

Holdrege silt loam, colluvial phase.—Holdrege silt loam, colluvial phase, differs from Holdrege silt loam chiefly in its slightly deeper and darker surface soil, a result of its lower-lying position which has favored the accumulation of considerable surface wash from the higher levels. The color, structure, and texture of all subsoil horizons are similar to those in Holdrege silt loam. In many places the soil has been considerably modified by alluvial deposits and somewhat resembles terrace or bench land, but it is usually more sloping and for this reason was included with the upland soils.

Soil of this phase occurs in numerous small bodies in nearly all parts of the county except the northwest part. Some of the largest areas are in Tappan and Turner Valleys. The tracts are smooth, with a decided slope toward the center of the valleys. Drainage is thorough though not excessive, and the soil is not subject to destructive erosion. It receives considerable moisture through seepage from the higher-lying soils.

Soil of this kind is only locally important in the agriculture of the county, on account of the small size of most of the areas. It is

equal to the best upland and terrace soils in natural productiveness, however, and practically all of it is under cultivation, mainly to corn, alfalfa, wheat, and oats, yields of which average slightly higher than on Holdrege silt loam.

HOLDREGE VERY FINE SANDY LOAM

The surface layer of Holdrege very fine sandy loam is dark grayish-brown loose pulverulent very fine sandy loam, having no definite structure but consisting of a dustlike surface covering or mulch from one-half to 2½ inches thick. It is underlain by 3 or 4 inches of very dark grayish-brown or almost black material which differs little in texture but has an irregularly developed bedded or layered structure and a horizontal cleavage giving the material a platy or laminated appearance. Beneath the laminated layer is the lower layer of the surface soil which is similar in color to the surface layer but differs from either of the layers above in its slightly larger silt and clay content, greater coherence, and development of a faintly columnar structure. The material breaks into a coarsely granular or nutlike mass. These three horizons are sharply defined throughout virgin areas of Holdrege very fine sandy loam in Custer County, and their combined thickness ranges from 8 to 12 inches. The heavier upper subsoil layer and the underlying loess are similar to corresponding horizons of Holdrege silt loam. In cultivated fields the thin surface mulch and the laminated or platy subsurface horizon have become so thoroughly mixed and pulverized by constant stirring as to obscure their original structural characteristics.

The surface soil is normally rich in organic matter, although the content varies somewhat with the relief, being greater on level areas and gradual slopes where conditions have favored the growth and decay of plant life and soil weathering has progressed undisturbed by erosion. In such places the surface horizon is almost black and is from 14 to 18 inches deep. Around the margins of the soil, however, where the slopes to Colby areas are usually steep, the organic-matter content and thickness of the surface layers gradually decrease, and in many places it is difficult to separate this soil from the lower-lying Colby soils.

This soil has developed, in part,, through weathering from the loessial deposit which once covered the entire county. The sandy texture of the surface soil is owing largely to the incorporation of wind-blown material from the more sandy soils of the region.

Holdrege very fine sandy loam occurs chiefly in the western and southwestern parts of the county where it occupies uniform and predominantly large bodies on the Odencrantz, Hansen, Talline, Judkin, and West Tables. Smaller though uniform developments are on the Murphy, Grautman, and Mull Tables and on less eroded divides between drainage ways. The soil is not extensive in the eastern half of the county, although rather large areas occur in Garfield and Westerville Townships, and small scattered bodies may be found wherever sandy materials are sufficiently abundant to give the top-soils a very fine sandy loam texture.

Areas of this soil range from nearly level to steeply rolling, but most of the land is strongly undulating or gently rolling. The more nearly level areas occur mainly on some of the highest positions in

the county and represent remnants of the original smooth loess plain which have escaped destructive erosion. Drainage is good though seldom excessive except on the steeper slopes.

This is one of the best upland soils of Custer County, and is considered equal to Holdrege silt loam in productiveness. It is naturally strong, fertile, and retentive of moisture, and all crops common to the region produce well in favorable seasons. Owing to the more sandy surface soil, it can be tilled under a somewhat wider range of moisture conditions than the Holdrege soil. The large content of silt and organic matter prevent excessive wind erosion even in the driest years.

Practically all the soil is under cultivation to corn, oats, wheat, and alfalfa which yield about the same as on Holdrege silt loam. The soil is handled in the same manner as the silt loam. However, the texture of this soil is more favorable to the formation of a surface mulch, and during dry seasons crops withstand droughts better than on Holdrege silt loam.

Holdrege very fine sandy loam, colluvial phase.—The surface soil of Holdrege very fine sandy loam, colluvial phase, differs from that of Holdrege silt loam only in its higher sand content and therefore slightly coarser texture. In a few places the surface material contains enough sand to approach a fine sandy loam, but this variation is not sufficiently extensive to warrant separation on the soil map. The subsoil is similar to that underlying Holdrege very fine sandy loam.

Soil of this phase occurs in scattered and usually small bodies throughout the central and southwestern parts of the county, generally occupying narrow stream valleys and long gradual slopes between the uplands and terraces. Where terrace or bench formations are not developed, however, the soil may extend to the stream channel. Drainage is good though not excessive.

On account of its small extent this is not an important agricultural soil in Custer County. Only a few farms consist of this soil alone. However, it is as strong and fertile as any soil in the county and is nearly all used for crop production. Crop yields average about the same as on Hall silt loam and Hall very fine sandy loam, and the land has about the same agricultural value.

HOLDREGE FINE SANDY LOAM

Virgin areas of Holdrege fine sandy loam are characterized by a 2 to 4 inch layer of loose structureless fine sandy loam, underlain by a 4 to 7 inch layer of similar-textured platy or laminated material which in turn rests on a 5 to 6 inch layer of loose friable fine sandy loam having an imperfectly developed nutlike or small cloddy structure. This soil differs from Holdrege silt loam and Holdrege very fine sandy loam mainly in the texture of the three surface soil layers, or A horizon. The B and C horizons are similar to corresponding layers in other soils of the Holdrege series. The organic matter, abundant in the surface horizon, decreases gradually with depth and only slight traces occur below 3½ or 4 feet.

On the shoulders of hills and the steeper slopes leading to the lower-lying Colby soils, the surface horizon in many places has been greatly thinned by erosion and in places entirely removed, exposing the lighter-colored subsoil. Where such areas are of suffi-

cient size to warrant mapping they are included with the Colby soils. Most of them, however, do not exceed a few square rods and are included with Holdrege fine sandy loam in mapping.

Areas of this soil range from gently undulating to steeply rolling. Most of the surface is somewhat less even than that of areas of Holdrege silt loam or Holdrege very fine sandy loam. Drainage is good though seldom excessive.

This soil occurs in small scattered bodies throughout the southwestern, central, and north-central parts of the county. The largest area, which includes about 6 square miles, lies in a long narrow strip along the western edge of Talline Table in Elim Township.

On account of its small extent Holdrege fine sandy loam is not an important agricultural soil in Custer County. It is naturally strong and productive, however, and in general produces as good crop yields as the finer-textured members of the Holdrege series. The high sand content of the surface horizon favors the establishment of a good surface mulch and crops seem to withstand droughts even better than on Holdrege very fine sandy loam. Small-grain crops usually yield a trifle less, owing to the loose sandy texture of the seed bed.

COLBY SILT LOAM

The surface soil of Colby silt loam extends to an average depth of 6 inches, and most of the virgin areas of this soil are composed of two layers (A_1 and A_2). The A_1, or surface, horizon which seldom exceeds 2 or 3 inches in thickness, has accumulated more vegetable material or organic matter and is consequently darker in color than any other horizon. It consists of grayish-brown or dark grayish-brown friable silt loam which contains considerable clay though very little sand. It has a single-grain or floury structure. The A_2, or subsurface, horizon is about 4 inches thick. In texture it is similar to the layer above, but the color is decidedly lighter, being light gray or light grayish brown, and the structure is faintly granular. The granules, which are subangular or rounded, are about the size of bird shot. The material in this layer is very friable and crushes easily between the fingers. The two surface layers are well defined in virgin areas, but in cultivated fields they are thoroughly mixed, the entire A horizon being uniform grayish-brown friable single-grained silt loam.

The upper subsoil layer, or B_1 horizon, is about 10 inches thick and consists of very light-gray silt or silty clay which breaks into small angular clods or nutlike lumps about 1 inch in diameter. The material has not developed the imperfectly granular structure of the layer above and is very friable. The upper part of this horizon is sharply defined, but the lower part merges gradually with the horizon below. The lower subsoil layer, or B_2 horizon, is the zone of maximum carbonate accumulation. It ranges in thickness from about 10 inches to more than 2 feet and consists of pale grayish-yellow or almost white silty flourlike material. Specks, streaks, and splotches of white lime are abundant, and locally the soil material contains numerous angular lime concretions ranging from one-eighth to one-fourth inch in diameter.

The parent material, or C horizon, lies at a depth ranging from 2½ to 4 feet beneath the surface and consists of light-gray floury silt containing scattered rust-colored spots below a depth of 50 or 60 inches. The material is a trifle less coherent than the layer above, owing probably to its slightly lower lime content. The parent material, which is loess, little altered by weathering, extends downward without marked change throughout the loess deposit.

All the soil horizons except locally the A_1 horizon contain sufficient lime to react strongly with hydrochloric acid, but the B_2 horizon contains the largest amount of carbonates. The organic matter, so deficient in the surface soil, decreases rapidly with depth, and the lower B and C horizons are practically devoid of this material.

The surface soil of Colby silt loam varies in thickness and color, depending on the relief. It is deepest and darkest where conditions have been most favorable for undisturbed weathering and the accumulation of organic matter as on the more gradual slopes and rounded hilltops. On the steeper slopes and sharper ridge crests the A horizons when present are invariably thin and light in color. In many places erosion has entirely removed both surface layers, exposing the very light-gray upper subsoil layer. Where this condition exists all soil horizons are poorly developed or entirely absent and the material consists of loose floury loess, the surface layer of which has been only slightly darkened by organic matter.

Variations in texture, owing to an admixture of various amounts of wind-blown sand, occur throughout areas of this soil. In a few places within the loess, scattered sand pockets have been responsible for changing the surface texture of the surrounding soil from silt to very fine sandy loam or even pure sand, but as these pockets occupy only a few square rods and seldom influence more than 3 or 4 acres of soil, they have been included with Colby silt loam in mapping. A few patches of Colby silty clay loam in which the finer-textured materials of the high-lying soils have been washed down and deposited on the more gradual slopes, are also included.

Colby silt loam, together with its broken phase, is the most extensive soil in Custer County. It occurs throughout the uplands in all parts of the county except the northwest corner. It occupies continuous bodies covering the greater part of entire townships and also occurs as narrow strips on the slopes along drainage ways. It has developed wherever erosion has greatly thinned or entirely removed the dark-colored surface horizon of the Holdrege soils and may be regarded as an eroded phase of Holdrege silt loam.

Areas of this soil range from steeply rolling to hilly. They occur on fairly steep slopes and moderately sharp divides between stream channels. The relief is intermediate between that of the gently undulating or rolling areas of Holdrege silt loam, which cap the broader divides, and the extremely eroded, gullied, and dissected areas of Colby silt loam, broken phase.

Drainage is everywhere thorough and on many of the steeper slopes is excessive. In some places erosion has become serious and areas of Colby silt loam, broken phase, are gradually extending. The soil is retentive of moisture if surface run-off is artificially controlled.

Owing to its large extent Colby silt loam is an important agricultural soil in Custer County. However, its relief as a whole is rather unfavorable to cultivation. About 70 or 75 per cent of the land is under cultivation, and the rougher areas are used for grazing purposes and hay production. The native vegetation consists of a luxuriant growth of grama grass, redtop, western wheatgrass, bluestem, and many other nutritious grasses, and will support from 150 to 200 head of cattle or horses to the section during the summer grazing season.

On the cultivated areas all farm crops common to the region can be successfully grown, but corn, wheat, and alfalfa are the most important. The soil is well adapted to orchard fruits, but the climate is rather unfavorable to fruit production and yields are uncertain. Grain and hay yields average a little lower than those obtained on Holdrege silt loam. The high lime content and loose friable structure of this soil make it well suited to alfalfa, and this crop is an excellent one for the soil as it retards erosion, adds nitrogen, and increases the organic-matter content.

Soil of this kind is easily handled and can be cultivated without injury under a rather wide range of moisture conditions. It tends to clod if plowed when wet, but the lumps are easily reduced. Barnyard manure is applied when available, but commercial fertilizers have never been used in growing the staple crops. Crop rotation is not systematically practiced, but most farmers change their crops frequently and keep a part of their land in alfalfa.

The most urgent need of this soil is means to control excessive erosion and to conserve and increase the naturally low organic-matter content. In its virgin state the soil is naturally productive. Its relief, however, is unfavorable for the accumulation of organic matter when the soil is used for crops, and under present management the areas of Colby silt loam, broken phase, are gradually increasing at the expense of the typical soil. Liberal applications of barnyard manure, straw, or other coarse vegetable matter should prove beneficial. The frequent growing of alfalfa, sweetclover, or other legumes and the occasional plowing under of one of these crops will greatly aid in increasing the nitrogen and organic-matter content of the soil. Straw from old stacks should be hauled and spread over the land rather than burned or left to decay. Deep plowing with the furrows following the contours of the slopes will aid in checking erosion. The steeper slopes should probably be left in pasture, or if cultivated should be handled in such a way that alternating strips of sod and plowland extend at right angles to the slopes. Where incipient gullies have developed the problem of checking erosion becomes more difficult. Dams of straw, wire, or rubbish held by posts will retard the velocity of the run-off, thereby causing the streamlets to deposit their sediment and gradually refill the depressions.

Colby silt loam, broken phase.—Colby silt loam, broken phase, includes the rougher and more severely eroded areas of Colby silt loam where the surface soil has been removed almost as fast as it has formed, and soil weathering has been retarded to such an extent that the greater part of the soil has not developed definite A and B horizons but consists chiefly of unweathered or only slightly weathered loess. A very small quantity of organic matter gives the

shallow surface soil a somewhat darker color than the subsoil. The material becomes gradually lighter in color with depth, and at a depth ranging from 16 to 24 inches is almost white, loose, floury calcareous silt. Soil of the broken phase occurs chiefly in the northeastern, central, and southwestern parts of the county where it occupies the greater parts of several townships.

The surface is everywhere rough and hilly except along the narrow canyon floors, which are level and gently sloping. All areas of this soil are dissected by intermittent streams which have cut ravines from 75 to 100 feet deep, and in places almost perpendicular-walled valleys. Soil slipping is common and many of the steeper slopes present a succession of short vertical exposures, locally known as catsteps. The divides are sharp and crestlike. Drainage is excessive.

Most of this broken soil is used for grazing land, probably not more than 5 per cent being cultivated. The only tillable areas are the more gradual slopes, the narrow canyon floors, and scattered included areas of Holdrege silt loam which were too small to show on a small-scale map.

A few very severely eroded slopes are almost bare of vegetation or support only a sparse growth of pasture grasses, weeds, or shrubs including sumac, chokecherry, and raspberry. However, over most of the land there is a good growth of nutritious pasture grasses, including grama, wheat, and little bluestem grass. This vegetation will support from 100 to 150 head of cattle to a section during the summer grazing season. In the grazing areas the number of animals per unit of land should be kept well within the carrying capacity of the range as heavy grazing destroys the protective grass covering and results in excessive erosion. Several of the canyons in the northeastern part of the county are covered with dense stands of dwarf red cedar, some of which is suitable for post material. Some dwarf ash, hackberry, elm, and cottonwood occur locally along the canyons.

COLBY VERY FINE SANDY LOAM

The surface layer, or A_1 horizon, of Colby very fine sandy loam consists of 2 or 3 inches of grayish-brown loose single-grain material composed largely of silt, very fine sand, and organic matter. The organic matter is in various stages of decay, though the greater part is not thoroughly decomposed and remains more or less fibrous. This horizon is underlain by 3 or 4 inches of dark grayish-brown very fine sandy loam, the A_2 horizon, which is similar in texture and structure to the layer above but is slightly darker in color, the organic matter being more abundant and more thoroughly decomposed.

The next horizon is the subsoil, or B horizon, which contains more very fine sand than the corresponding horizon of Colby silt loam. The underlying parent material is loess. The organic matter, seldom abundant even in the surface soil, decreases rapidly with depth and is scarcely noticeable below a depth of 20 inches except where grass roots penetrate the C horizon.

The surface soil varies considerably in the amount and grade of its sand content. Around the margins of areas occupied by this soil the texture of the surface soil becomes gradually coarser or finer until it corresponds to that of adjoining soils. In marginal localities the sand content of the subsoil also varies considerably.

Areas of this soil are steeply rolling or hilly, but are not quite so rough as areas of Colby silt loam, the divides being somewhat broader and more rounded and the slopes more gradual than in areas of the silt loam. Drainage is good, and in the more hilly sections the run-off is rapid and erosion severe. However, the soil is retentive of moisture in places where the surface run-off is artificially controlled.

Colby very fine sandy loam occurs in numerous, usually small, bodies scattered throughout the central, southern, and southwestern parts of the county. A typical area lies on both sides of Custer Canyon in Ryno Township.

On account of its smaller extent this soil is not so important agriculturally as Colby silt loam. It is a fair farming soil, however, and equals Colby silt loam in productiveness. About 70 per cent of the land is under cultivation; the rest, including the rougher areas, is used for pasture and hay land. The native vegetation includes those grasses which thrive on Colby silt loam and in addition considerable sand grass and stipa or needle grass.

Colby very fine sandy loam, broken phase.—The broken phase of Colby very fine sandy loam includes those areas of Colby very fine sandy loam which are so rough and broken as to be suitable chiefly for pasture. Surface run-off has removed the organic matter almost as fast as it has formed, and the soil consists largely of light-gray or pale yellowish-gray floury calcareous loess, in which only 2 or 3 inches of the surface soil is darkened by organic matter. In many places the organic material has been entirely removed, exposing the loessial deposit.

This broken soil occurs in both large and small irregular-shaped bodies, chiefly in the southwestern quarter of the county. Some of the largest areas are south of West Table and east of Stop Table in the west-central and southwestern parts, respectively. A large body borders Murphy Table and smaller areas are south of Callaway, south of Redfern Table, northeast of Lodi, and along the east edge of Talline Table.

All the areas are rough and broken, stream erosion having carved the surface into an intricate system of narrow canyons and sharp ridges. The relief, however, is not quite so severe as in areas of Colby silt loam, broken phase. Soil slipping and the development of catsteps is less pronounced in this soil than in Colby silt loam. Drainage is excessive.

The greater part of the soil is used as grazing land. Probably not more than 15 per cent, including the more gradual slopes, is under cultivation. All crops common to Colby silt loam are grown. The native vegetation includes grama grass, bluestem, sand grass, and stipa or needle grass.

This soil is preferred to Colby silt loam for grazing purposes because most of it supports a slightly heavier vegetation and has a somewhat less rugged relief. The cultivable areas should be carefully managed to prevent excessive erosion.

COLBY FINE SANDY LOAM

Colby fine sandy loam differs from Colby very fine sandy loam mainly in having a fine sandy loam surface soil instead of very fine sandy loam. Its upper subsoil layer consists of grayish-brown or

light grayish-brown cloddy fine sandy loam or very fine sandy loam which continues to an average depth of 8 inches. This layer is easily distinguished from the surface soil by its difference in color and structure. The B_2, or lower subsoil horizon, is light grayish-brown loose incoherent silty very fine sand which continues to an average depth of 24 inches. The next, or C horizon, is the parent material which consists of almost white highly calcareous loess similar to that underlying Colby silt loam.

In many places erosion has removed the thin surface horizon, exposing the grayish-brown cloddy upper subsoil layer, and on a few of the steeper slopes the A and B horizons have been washed away entirely, exposing the highly calcareous parent material, the surface material of which is only slightly darkened by organic matter.

Colby fine sandy loam occurs in scattered bodies chiefly in the north-central and southwestern parts of the county. One of the largest areas, comprising about 2 square miles, lies south of Eureka Valley in Arnold Township.

Areas of this soil range from gently rolling to hilly. By far the greater part of the land is sharply rolling and is cut by narrow V-shaped valleys along the larger drainage ways. The valley sides, however, are less steep and the divides are more rounded and usually broader than those of Colby very fine sandy loam. Drainage is good and in the rougher areas is excessive.

This is a fair farming soil, and where carefully managed is well suited to all crops common to the region. About 70 per cent of the soil is under cultivation, principally to corn, wheat, alfalfa, oats, and rye. Crop yields, with the possible exception of corn, are somewhat lower than on the heavier members of the Colby series. As the soil is subject to drifting in some places, it requires more careful management than either Colby silt loam or Colby very fine sandy loam. However, it is less subject to water erosion than Colby silt loam and Colby very fine sandy loam, as more of the moisture is absorbed by the loose porous surface soil and subsoil.

Colby fine sandy loam, broken phase.—The broken phase of Colby fine sandy loam includes those areas of Colby fine sandy loam in which stream erosion has so dissected the land as to make it unsuited for any purpose except grazing. The surface layers have been removed almost as fast as they have formed, and the soil consists largely of exposed patches of light-gray or almost white sandy loess with intervening areas in which the upper 2 or 3 inches have been slightly darkened by organic matter. Lime is present at various depths depending on the severity of erosion and the sand content of the soil. On the steeper more gullied slopes, where erosion has been excessive, the carbonates may extend to the surface of the ground. In many of the more sandy and less eroded areas, however, the carbonates have been leached to a depth of 4 or more feet. Most of the soil is calcareous within 2 feet of the surface. The sand content generally decreases with depth and most of the material below a depth of 4 feet consists of almost white loose floury silt containing only a small amount of very fine sand.

Colby fine sandy loam, broken phase, is developed chiefly in the western and southwestern parts of the county. The largest areas, which cover many square miles, are in Arnold, Cliff, and Triumph Townships.

The surface of this soil is rough and broken, but the relief is less harsh and angular than in areas of the corresponding phases of Colby silt loam and Colby very fine sandy loam. In a few places the surface is somewhat similar to that of wind-blown areas of loose sand. Drainage is excessive, and erosion is severe.

Most of this soil is used for grazing land. The native vegetation consists chiefly of grama grass, sand grass, and stipa or needle grass and will support from 100 to 150 head of cattle to the square mile during the summer grazing season, from June to October.

COLBY LOAMY SAND

The A horizon of Colby loamy sand to an average depth of 3 inches is dark grayish-brown incoherent material composed of a mixture of all grades of sand, the fine and medium grades predominating. It contains sufficient organic matter to give it a loamy texture but seldom enough to prevent soil drifting when the native sod is disturbed.

The B_1, or upper subsoil horizon, which lies between depths of 3 and 12 inches, consists of grayish-brown fine sandy loam or very fine sandy loam containing sufficient silt and clay to loosely bind the mass together. The material breaks into small, irregular-shaped lumps, from one-half to 1 inch in diameter, which are easily reduced between the fingers into a loose incoherent mass. This zone is poorly supplied with organic matter, but it has evidently received some fine material from the surface horizon and is slightly more coherent than that layer. The second layer of the subsoil, or B_2 horizon, extends to an average depth of 20 inches. It is the zone of maximum concentration of the fine materials from above, and consists of light-gray very fine sandy loam containing an abundance of silt and some clay. The material breaks into clods similar in size and shape to those of the layer above but the lumps are firmer. The three horizons are clearly defined and readily distinguishable in stream and road cuts. They have all been leached of their carbonates, and no visible lime reaction is obtained when acid is applied. The lowest layer, although finer in texture and more dense than either of those above, bears no resemblance to a claypan but remains very friable throughout. The next layer of the subsoil, the B_3 horizon, is similar in color to the one above but contains less fine material, being loose rather incoherent very fine sandy loam, in most places showing faint traces of lime. This layer becomes gradually lighter in color, finer in texture, and more calcareous to a depth of about 60 inches where it merges with the light grayish-yellow or almost white silty parent loess.

In cultivated fields the surface horizon is usually lighter in color and even less coherent than in virgin areas. This is owing to the removal of much of the organic matter by the wind when the sod is disturbed and the soil pulverized.

Colby loamy sand occurs in scattered bodies chiefly in the north-central and west-central parts of the county. One of the largest areas, which includes about 640 acres, is north of Walworth School in Milburn Township.

Areas of this soil range from undulating to hilly. By far the greater part of the land has a choppy surface resembling that formed

by wind in loose sand. Surface drainage is poorly established except in the rougher sections where run-off is rapid and erosion severe. The loose porous soil and subsoil, however, cause excessive underdrainage, and in dry years crops sometimes suffer from lack of moisture.

About 50 per cent of the soil remains with its native covering of grasses, chief among which are bunch grass, sand grass, bluestem, and stipa or needle grass. Some grama grass grows on the more nearly level areas. The grazing of beef cattle is the chief industry. The native grasses will support about 200 cattle or horses on a section of land during the summer grazing season, or when cut for hay will yield from one-fourth to one-half ton to the acre.

Corn, which is the leading cultivated crop, yields from 15 to 30 bushels to the acre, depending on the rainfall. Alfalfa yields from 1¼ to 2 tons usually from two cuttings, though in favorable seasons a third crop, which increases the total yield about one-half ton, is obtained. It is extremely difficult to prepare a sufficiently compact seed bed for alfalfa, but the crop does fairly well after a good stand is obtained. Small grain is seldom grown on account of the danger of soil blowing with consequent injury to the shallow root systems. Methods recommended for handling other Colby sandy soils apply equally well to this soil.

COLBY SAND

Colby sand differs from Colby loamy sand mainly in its lack of finer materials. It is loose and incoherent and contains barely sufficient organic matter to slightly darken the natural gray color of the sandy material. In cultivated fields most of the organic matter has been removed, and the surface soil is light grayish brown. The lower layers are similar to the corresponding layers of Colby loamy sand.

Areas of this soil range in texture from very fine sandy loam to almost pure sand within a distance of only a few feet. In some places sand has covered the soil material to a depth of 2 or 3 feet. In such places no lime reaction can be obtained within 4 or 5 feet of the surface. Where such areas are of sufficient size to warrant mapping they are included with the Valentine soils. In many places wind and stream erosion have removed the surface soil and a part of the subsoil, and on many of the steeper slopes all weathered soil material has been washed away exposing the light-gray or almost white highly calcareous loess. The soil simply represents areas of eroded loessial material which have been covered to various depths by wind-blown sands. The sand is evidently of comparatively recent deposition as it has not become mixed with the underlying loess to a great depth nor has it accumulated much organic matter.

Areas of this soil range from gently undulating to hilly, but most of them have a gently rolling or choppy relief such as is produced by wind on loose sand. Drainage is thorough. Surface channels are poorly established except on the steeper slopes where the run-off is rapid, but the porous sand affords ample underdrainage. In many of the areas which are deeply covered with sandy deposits underdrainage is excessive, and vegetation suffers from lack of moisture

during prolonged droughts. Where the sand mantle is thin, however, the soil seems to withstand drought better than any other Colby soil.

This soil occurs chiefly in the north-central part of the county, and a few small bodies are in the west-central part. The largest area, comprising about 3½ square miles, borders River Canyon southwest of Milburn.

About 30 per cent of the land is used for crop production and the remainder, including the rougher areas and those more deeply covered with sand, is used for hay and pasture land. The native grasses are the same as on Colby loamy sand, and as a rule the vegetation is less dense. Grasses on a section of land will support from 100 to 150 cattle during the summer grazing season (June to October) or when cut for hay will yield from one-fourth to one-half ton to the acre, depending on the rainfall. The crops grown on Colby loamy sand are grown on this soil, but average yields are considerably lower.

It is extremely doubtful if more of this land should be brought under cultivation as the soil blows badly when the protective sod is destroyed, and the drifting sand usually influences a much larger area than that originally disturbed. The areas now under cultivation should be kept with a vegetable covering as much of the year as possible and should be cultivated only sufficiently to destroy weeds.

ANSELMO VERY FINE SANDY LOAM

In virgin areas of Anselmo very fine sandy loam the surface soil or A_1 horizon, is dark grayish-brown loose incoherent very fine sandy loam from one-half to 2 inches thick. It is underlain by a 3 or 4 inch layer of material, the A_2 horizon, which is similar in color and texture to the layer above but has a poorly defined laminated structure. The laminated material breaks into a finely granular mass, the granules being more or less rounded, many of them having two flat parallel faces and ranging from one-eighth to one-fourth inch in diameter.

The next layer, or B_1 horizon, is the upper layer of the subsoil. It is grayish-brown loose friable very fine sand extending to an average depth of 15 inches. The sand is low in organic matter but contains sufficient silt and clay to loosely bind the grains together. The soil material breaks into irregular-shaped clods, from one-half to three-fourths inch in diameter, which are easily crushed between the fingers into loose incoherent very fine sand. This horizon is underlain by a 14 or 16 inch transitional layer of slightly lighter-colored material differing little in texture or structure from the layer above. The B_2 horizon, or lower subsoil layer, is the zone of maximum concentration of fine-grained materials from the overlying layers. It is about 10 inches thick and lies between average depths of 25 and 35 inches. The zone is sharply defined and consists of grayish-brown very fine sandy loam containing a larger amount of silt and clay than any other horizon. Some fine and medium sand and a few small gravel, the gravel seldom exceeding one-sixteenth inch in diameter, are present. The horizon has an imperfectly developed stratified structure. The material breaks into coarsely granular aggregates, the granules averaging about one-fourth inch in diameter. More or less very finely granular and completely pul-

verized or single-grain material is also present. The granules are irregular in shape though many of them are characterized by two flat parallel faces marking the lines of stratification along which the material has broken.

Beneath this layer is the parent material, or C horizon, consisting of very light-gray fine incoherent sand which continues below a depth of 6 feet with little change.

Throughout virgin areas of this soil the surface soil, to a depth of 6 inches, is uniformly rich in organic matter and prevailingly dark. In cultivated fields, however, wind erosion has greatly reduced or almost entirely removed the organic material from the tops of the low knolls and ridges, giving the soil a characteristic light and dark spotted appearance. Anselmo very fine sandy loam is not noticeably calcareous in any place.

Areas of this soil vary considerably in the proportion and grade of sand in the several horizons and in the comparative thickness and depth of the different layers. The B horizon, however, except near small included patches of Valentine soils, is usually finer in texture and invariably more coherent than either the A or C horizons. The principal surface variation is toward fine sandy loam and small patches of soils of such texture are included with this soil, especially around the margins of the bodies, where the textures change so gradually that it is often necessary to draw arbitrary lines separating the soil types. The soil differs from soils of the Valentine series in that it has developed a definite subsoil, or B horizon, which is more coherent than any layer within the profile of the Valentine soils. It differs from the Colby soils in its more sandy C horizon, prevailingly darker surface layer, and lower lime content throughout the B and C horizons.

The development of this soil is not clearly understood. The parent material is probably the same as that underlying the Valentine soils and dune sand. However, to a depth of 1 or 2 feet the surface soil has been thoroughly mixed with loess, either carried in by wind from the near-by loessial deposits or transported to its present position as colluvial wash from the higher-lying loessial areas. Probably both wind and water have been responsible for the transportation and thorough mixing of the loess with the sandy material. Subsequent weathering and the accumulation of organic matter has created the present soil and subsoil.

This soil occupies a few small bodies in the north-central and west-central parts of the county where it occurs in close association with the Valentine soils and other members of the Anselmo series. One of the largest areas, comprising about 800 acres, borders the northern county line in T. 20 N., R. 19 W. A slightly smaller area is 3½ miles southwest of Milburn. A very typical area is 1 mile west of Anselmo. Small bodies lie east of Talline Table and northeast of Sand Valley School.

Areas of this soil range from almost level to gently rolling. By far the greater part of the soil occupies the broad undulating valleys between the Valentine soils or dune sand areas and the hard-land soils. The surface is characterized by low rounded hummocks and ridges with intervening shallow depressions, producing a more or less wavy appearance. Surface channels are not established but,

owing to the looseness and porosity of the soil and subsoil, underdrainage is everywhere thorough and in many places excessive. Crops sometimes suffer from lack of moisture during prolonged droughts.

This is not an important agricultural soil in Custer County on account of its small extent and somewhat droughty character. It is, however, more stable and more retentive of moisture than any of the Valentine soils, and about 80 per cent of it is under cultivation, the remainder being used for grazing and hay land. Corn is the chief crop though some wheat, alfalfa, and sweetclover are grown. The native grasses on this soil will support from 125 to 200 head of cattle to a section during the summer grazing season, or when cut for hay will yield from one-fourth to one-half ton to the acre, depending on the rainfall.

ANSELMO FINE SANDY LOAM

Anselmo fine sandy loam contains a coarser grade of sand than Anselmo very fine sandy loam, and the upper layers are more incoherent. The underlying sand is similar to that under the very fine sandy loam. This soil has probably been formed in the same manner and from the same materials as the very fine sandy loam member of the Anselmo series but has evidently accumulated a larger proportion of fine sand in its surface horizon.

Anselmo fine sandy loam occurs in large and small bodies in the north-central and west-central parts of the county. One of the largest areas, comprising about 4 square miles, is in Delight and Elim Townships.

Areas of this soil are prevailingly undulating. They are characterized by low rounded knolls and ridges with intervening shallow depressions such as would result from wind action in areas of pure sand. Surface drainage is not established, but the loose porous soil and subsoil afford ample and in many places excessive underdrainage. The soil is not retentive of moisture, and crops sometimes suffer from droughts.

About 70 per cent of the soil is farmed, chiefly to corn. Some alfalfa and wheat are grown. The land, however, is not well suited to small grain or alfalfa on account of the loose incoherent character of the seed bed which favors soil blowing with consequent injury to the young plants.

ANSELMO LOAMY SAND

Anselmo loamy sand contains a larger proportion of sand than the fine sandy loam member of this series and is more incoherent. The organic matter, although plentiful in the surface soil of virgin areas, decreases rapidly with depth and is scarcely noticeable below 18 or 20 inches. In cultivated fields the constant stirring of the soil has decreased its coherence and much of the organic matter has been removed by the wind. The surface layers in the older fields are much lighter in color than those in virgin areas. The soil is deficient in lime. This soil has probably developed in the same manner, though from slightly coarser materials than those from which other members of the Anselmo series have weathered.

Anselmo loamy sand occupies a few large and small bodies, chiefly in Delight, Milburn, and Victoria Townships, where it occurs in close association with other members of the Anselmo series. Two of the largest areas, including more than 3 square miles each, are in Victoria Township.

The surface of this soil is hummocky or choppy. It is characterized by low rounded knolls and ridges with intervening shallow depressions. In cultivated fields the organic matter has been largely removed from the exposed knolls and ridge tops giving the surface a characteristic dark and light spotted appearance. Surface drainage is not established, but underdrainage is thorough and, owing to the looseness and porosity of the soil and subsoil, is in many places excessive. On account of the low water-retaining power of the soil prolonged droughts sometimes injure crops.

Anselmo loamy sand is inextensive, incoherent, and somewhat droughty, and therefore not an important agricultural soil in Custer County. It is, however, more stable and in all respects a better farming soil than any of the Valentine soils. About 70 per cent of the land is under cultivation, and the remainder is used for pasture and hay land.

The native vegetation is similar to that on the sandy loam members of the Anselmo series. The same crops are grown, but average yields are somewhat lower.

The urgent requirement for the improvement of this soil is more organic matter to incease its stability and water-retaining capacity. Liberal applications of barnyard manure, coarse straw, or other vegetable matter; the growing of sweetclover; and the occasional plowing under of this crop are all beneficial and would greatly increase the producing power of the land.

VALENTINE SAND

The surface soil of Valentine sand consists of loose, incoherent grayish-brown sand from 6 to 10 inches deep. The upper 3 or 4 inches is usually somewhat darker than the lower part, locally attaining a dark grayish-brown shade, owing to a small content of organic matter. The organic-matter content, however, is not sufficient to prevent the soil from drifting when the protective vegetation is removed. The subsoil, which continues to a depth ranging from 24 to 30 inches, differs from the surface soil only in its lower organic-matter content and consequently lighter color. In most places it is light grayish brown, though it may be tinged with yellow. The color becomes gradually lighter with depth until the material merges with the very light-gray parent sand which contains sufficient silt and clay to make it slightly coherent. Below a depth of 4 or 5 feet the silt and clay disappear, and the material is similar to that underlying dune sand. Neither the soil, subsoil, nor parent material contains sufficient lime to noticeably react with hydrochloric acid. The sand of which this soil is so largely composed consists chiefly of quartz and feldspar of the medium, fine, and very fine grades, the medium sand predominating.

The color and depth of the surface soil vary somewhat according to the topographic position of the areas. In shallow depressions,

where conditions have been most favorable for the growth and decay of plant life, the soil is somewhat darker and deeper than elsewhere. On the crests of knolls and ridges, however, the organic matter has been largely removed by wind, leaving the soil very shallow and prevailingly light in color. In many cultivated areas the light color prevails even in the depressions, as the frequent stirring of the surface soil favors excessive wind erosion and the consequent removal of organic matter.

A variation of Valentine sand occurs in small areas on the terraces of Middle Loup and South Loup Rivers. Here the surface sand does not differ widely from that of the typical soil, but at a depth of about 24 inches it is underlain by light-gray almost pure sand. In a few places, the material below a depth of 24 inches is composed largely of coarse sand and gravel. In cultivated fields, from which wind has removed the organic matter, the surface horizon is almost pure sand, and it drifts badly when not protected by vegetation. This included soil has a somewhat lower agricultural value than the typical areas. It overlies coarse-textured alluvial deposits which are now elevated and well drained. Wind-blown sands have also modified the surface soil in some places.

Typical Valentine sand has been formed by the partial weathering of sand, most of which has probably been transported by wind from the vast sand-hill region to the west, though some has undoubtedly come from sandy strata within the loess. The original material has been so thoroughly reworked and reassorted that it is difficult to accurately determine its origin.

Valentine sand occurs chiefly in the northwestern part of the county where it occupies the dry valleys within and around the sand hills.

Areas of this soil range from almost flat to steeply rolling, most of them presenting a hummocky or billowy appearance. Even the flatter areas are usually modified by scattered low rounded knolls and ridges. Drainage is everywhere thorough and in many places excessive. There is very little surface run-off, but the loose porous sands absorb and carry off the moisture as fast as it accumulates.

Valentine sand is of little value for crop production on account of its low humus content, low water-retaining capacity, and danger of drifting when the native sod is destroyed. Probably not more than 40 per cent of the land is under cultivation. Corn and some alfalfa are grown in the lower depressions where moisture conditions are most favorable and the relief affords some protection against excessive wind erosion. Most of the land remains with its original covering of grasses and is used for grazing cattle and for hay production. The native vegetation, which consists of sand grass, stipa, and big and little bluestem, will support from 100 to 125 head of cattle to the square mile during the summer grazing season, or when cut for hay will yield from one-fourth to three-fourths ton to the acre, depending on the rainfall.

VALENTINE LOAMY SAND

The surface soil of Valentine loamy sand is grayish-brown or dark grayish-brown incoherent fine or medium sand containing sufficient organic matter to give the material a loamy texture. It differs from

Valentine sand chiefly in texture and the slightly higher content of organic matter. The parent material of loose incoherent fine or medium gray sand lies at a depth ranging from 24 to 40 inches and continues uniform beyond a depth of 6 or 8 feet.

This soil occurs in scattered bodies, chiefly in the northern part of the county. One of the largest areas, comprising about 800 acres, is on the north side of Middle Loup River 2 miles northeast of Walworth Bridge. On the terrace of Middle Loup River south and west of Sargent about 700 acres of very sandy soil has been included with Valentine loamy sand. It differs little in profile from typical Valentine loamy sand and has about the same agricultural value.

Areas of Valentine loamy sand are flat or rolling, and are broken by numerous small ridges and knolls with intervening shallow depressions. Surface drainage has not been established as the rainfall readily sinks into the porous sand and there is practically no run-off. The soil is not very retentive of moisture.

On account of its small extent, unstableness, and low water-retaining power, Valentine loamy sand does not have a high agricultural value in Custer County. However, it is a much better farming soil than Valentine sand, and about 60 per cent of it is under cultivation, mainly to corn; the rest is used chiefly for hay land. Some alfalfa is grown but the soil is not well suited to this crop, on account of the difficulty of obtaining a sufficiently compact seed bed for good germination.

VALENTINE FINE SANDY LOAM

The surface soil of Valentine fine sandy loam is grayish-brown loose friable fine sandy loam from 5 to 7 inches thick. The upper 2 or 3 inches is usually a little darker than the remainder of the layer, owing to a slightly higher organic-matter content. This layer is underlain by a layer of light grayish-brown or grayish-yellow very fine sandy loam about 8 inches thick which contains considerable silt and clay, probably washed down from the layer above, and has a slightly firmer consistence than any of the other layers. When dropped, a lump of this material will break into small angular clods from one-half to three-fourths inch in diameter. The clods are very friable and are easily crushed between the fingers. The parent material lies below an average depth of 15 inches and consists of a gray or light grayish-brown incoherent mass of fine or medium sand which is uniform to great depths.

The soil is very low in lime. The organic matter, though fairly abundant in the surface horizon, decreases rapidly with depth and is practically absent below a depth of 10 inches except where scattered grass roots extend into the parent material.

The principal subsoil variation in Valentine fine sandy loam occurs in areas in which the sand has a rather high silt content. In many places the soil has no definite horizons but simply consists of grayish-brown incoherent fine or medium sand, the surface layer of which, to a depth of 5 or 6 inches, has been considerably darkened by organic matter.

Valentine fine sandy loam is developed chiefly in the northwestern and central parts of the county where it occurs mainly in small scattered areas, in close association with dune sand and other Valentine soils.

Areas of this soil are almost flat or rolling, most of them being gently rolling and modified in places by patches of hummocky or choppy land. The greater part of the soil lies somewhat below the general level of Valentine sand and Valentine loamy sand and has a less pronounced relief than those soils.

Drainage is good. Surface channels are not established, but the loose porous sands absorb and carry off the surplus moisture as fast as it accumulates. In many places underdrainage is excessive, and crops often suffer from lack of moisture. Areas of this soil in which the silt content is high are fairly retentive of moisture when carefully managed.

Valentine fine sandy loam is a fair farming soil, and about 80 per cent of it is under cultivation, the rest being used for pasture and hay land. The native vegetation is, in general, the same as on other Valentine soils. On the more silty areas some grama grass grows. Corn is the principal cultivated crop, and some wheat and alfalfa are grown.

GANNETT LOAMY SAND

The surface soil of Gannett loamy sand is very dark grayish-brown material composed of medium, fine, and very fine sand, together with a large proportion of well-decayed organic matter. The color and consistence of the material vary with the organic-matter content. In the more poorly drained situations the soil is almost black, is rather spongy, and is noticeably light in weight. In most places, however, the surface soil consists of a loose structureless mass of mixed sand and organic matter. Owing to the decreasing quantity of organic matter, the color of this layer becomes lighter with depth, and about 8 inches below the surface of the ground is a loose, incoherent mass of light-gray moist sand containing little or no organic matter. This soil differs from Valentine sand in that its surface soil has accumulated a larger amount of organic material and is more moist. In most places the soil is calcareous to a depth of 14 or 15 inches, but below this no lime reaction is obtained when acid is applied.

A few variations from typical occur in areas mapped as Gannett loamy sand. Some of the bodies contain so much fine sand and so little of the medium grades that they assume a fine sandy loam texture. In a few places the subsoil to a depth of about 30 inches contains considerable silt and clay which has probably been brought in from the higher-lying soils by surface wash and carried to the subsoil by percolating waters. Locally the greater part of this fine material has accumulated between depths of 3 and 5 feet, producing a bluish-gray waxy gritty layer. Below a depth of 5 feet the material is invariably loose incoherent gray sand similar to that underlying the Valentine and dune sand areas.

Gannett loamy sand occurs in a few scattered small basinlike depressions within the dune sand area in the northwestern part of the county. The bodies usually occupy the lowest positions within the basins or valleys. As the areas are flat or depressed, drainage in most places is poor. Marshes occupy many of the lower areas.

Owing to its small extent and poor drainage this soil is of little agricultural importance in Custer County. It is all used for pasture

and hay land. The native grasses will support 1 cow or horse to the acre during the summer grazing season or when cut for hay will yield about 1 ton to the acre. The hay is coarse and is less nutritious than that obtained on drier soils, but its greater yield offsets its lower value to a great extent. All the hay is fed on the ranches where produced.

This soil has a tendency to increase the general value of the ranch on which it occurs as it is the most valuable hay and pasture land in the sand-hill region.

SCOTT SILTY CLAY LOAM

The surface soil, or A horizon, of Scott silty clay loam, to an average depth of 8 inches, is black heavy silty clay loam rich in well-decomposed organic matter. It has a very finely granular structure, the small lumps having irregular angular shapes and ranging in diameter from one-sixteenth to about one-fourth inch. Very little dustlike or single-grain material is mixed with the granules.

The subsoil, or B horizon, includes several more or less poorly developed layers. In general, however, it consists of an upper, or B_1, horizon composed of very dark grayish-brown extremely compact clay extending to a depth of about 36 inches and a lower, or B_2, horizon of lighter-gray or grayish-brown moderately compact heavy silty clay. When dry, the upper layer of the subsoil breaks into large, irregular, angular lumps; when moist, it is tough, sticky, and plastic; and when very wet it has a smooth waxy feel. The dry exposed material is extremely hard and brittle and contains numerous seams, checks, and cracks, caused by shrinkage of the clay. The material in this layer is almost impervious to percolating or capillary waters and has the characteristics of a true claypan. The lower subsoil layer, which averages about 2 feet in thickness, contains less clay than the layer above, is only moderately compact, and breaks into small angular clods seldom exceeding 1 inch in diameter. It becomes gradually lighter in color and more friable with depth merging at a depth of 5 or 6 feet with the C horizon, or parent loess, of very light-gray or almost white silt which is little altered by weathering. This material is loose and floury and remains uniform to great depths.

The transition between the surface soil and upper subsoil layer is rather abrupt in most places, and the line of demarcation is readily distinguished. The subsoil horizons, however, merge gradually into one another through several poorly defined transitional layers, the material becoming gradually lighter in color and less compact with depth. This soil is very low in lime and no carbonate reaction is obtained at any point above the parent loess.

The principal textural variations are toward silt loam, and a few small bodies of Scott silt loam are included in mapped areas of this soil. Locally, a thin layer, from 2 to 4 inches thick, of ash-gray noncalcareous loose floury silt separates the surface soil and upper subsoil layers. In a few places the subsoil has a third, or lime horizon, seldom more than 5 or 6 inches thick, which rests directly on the parent loess and is very similar in color, texture, and structure to the lime zone underlying the Holdrege and Hall soils.

Scott silty clay loam occupies numerous small basinlike depressions, locally known as lagoons or buffalo wallows, throughout all the hard-land soils of the county wherever the relief is flat or gently undulating and the land free from erosion. It is most abundant throughout the Holdrege soils of the table-land areas but also occurs within the finer-textured Hall soils on the terraces. The basins seldom contain more than 160 acres, and most of them are much smaller. Drainage is poor, and in the spring after heavy rains water often stands on the surface for several weeks.

Owing to its small extent and poor drainage this soil is not used for crop production. The native vegetation includes sedges and other water-loving plants, with prairie grasses around the margins of the areas. The land has some value as hay land and for grazing purposes. Bodies occurring within cultivated fields are commonly considered waste land.

The greatest need of land of this kind is adequate drainage. However, this will only increase its grazing and hay value, as the compact subsoil is unfavorable to the growth of cultivated crops.

HALL SILT LOAM.

The profile of virgin areas of Hall silt loam in Custer County shows the following seven horizons: A_1, the surface layer, from one-fourth to 1 inch thick, is dark grayish-brown pulverulent silt loam of single-grain or imperfectly developed very finely granular structure. A_2, the subsurface horizon, from 2 to 4 inches thick, is very dark grayish-brown or almost black mellow silt loam having a laminated or platy structure similar to that in Holdrege silt loam and Holdrege very fine sandy loam. A_3, the lower surface soil, from 8 to 12 inches thick, is dark grayish-brown friable heavy silt loam having an imperfectly developed columnar form, the columns first breaking down into irregular angular granules, seldom exceeding one-eighth inch in diameter, and on further gentle pressure the granules becoming reduced to a loose floury silt. B_1, the upper subsoil horizon, from 1 to 2 feet thick, of grayish-brown silt loam differs from the layer above in its lighter color, slightly higher clay content, and somewhat coarser texture, but retains the faint columnar forms of the layer above, the granules being somewhat larger, averaging about one-fourth inch in diameter. B_2, a second subsoil horizon, the zone of maximum compaction, which has received much fine material carried down by percolating waters from the layers above, consists of grayish-brown moderately compact silt loam or silty clay loam which breaks into irregular angular clods about the size of walnuts. The lumps are rather firmly cemented and do not crush readily between the fingers but under moderate pressure can be reduced to loose floury silt or silty clay. This horizon, which is from 8 to 12 inches thick, appears more or less massive when exposed in a damp or moist cut. When dry, exposed surfaces contain numerous seams, checks, and cracks caused by shrinkage of the clay. B_3, the lower subsoil horizon, the zone of maximum carbonate accumulation, which has received the lime, originally abundant in the layers above, consists of loose floury very light-gray or pale-yellow silt containing numerous seams, specks, splotches, and fine winding threads of white lime. The material is more coherent when dry than in its natural moist condition, probably on account of the slight cementing effect

of the lime. This horizon ranges from 8 to 30 inches in thickness and in most areas lies below a depth of 4 feet. C, the parent material, or unweathered loess, consists of very light-gray or almost white loose floury silt having a high lime content. The lime is in finely divided form thoroughly mixed with the loess, and no spots of unusual concentration occur. Scattered rust-brown spots are noticeable below a depth of 5 or 6 feet. The material remains uniform below a depth of 12 feet, depending on the thickness of the original siltlike deposit.

Hall silt loam has developed on alluvial loessial materials deposited in the flood plains of streams when they were flowing at higher levels. Later intrenchment has left these deposits as terraces or benches now lying from 6 to 30 feet above the present channels.

In many places throughout virgin areas of this soil the surface soil is covered with a one-fourth to one-half inch layer of grayish-brown loose structureless very fine sandy loam, which closely resembles a dust mulch and has probably been carried to its present position from areas of more sandy soils by the wind. In many places the upper subsoil horizon is very poorly developed or entirely lacking, and the A_3 horizon rests directly on the zone of maximum compaction at a depth of about 16 inches. In such places the zone of carbonate accumulation also lies nearer the surface and is much thinner than typical. The lime zone, however, is seldom present above a depth of 3 feet regardless of the character of the layers above. In several places the B_2 horizon is much denser than typical, being heavy silty clay loam with the characteristics of a claypan. Such conditions exist over a rather large area northwest of Merna, in the vicinity of Berwyn, and throughout a part of the Wood River terrace around Lodi.

Hall silt loam occupies broad and narrow strips within many of the larger stream valleys throughout the county. It is extensive in Middle Loup River, Wood River, Clear Creek, and Mud Creek Valleys. It occurs also in Lees Park, Woods Park, and Round Valley.

Areas of this soil are flat or very gently undulating. Most of them are almost flat, sloping gently down the valley and toward the stream channels. Drainage is good but nowhere excessive.

Hall silt loam is one of the most productive soils in Custer County. It is naturally strong and fertile and will withstand severe cropping under poor management for several years, as it annually receives more or less organic matter through surface wash from the higher-lying soils. Practically all of it, except small bodies included in farmsteads and narrow strips along the highways, is under cultivation. All crops common to the region can be grown, and good yields are obtained, especially in seasons of high precipitation.

HALL VERY FINE SANDY LOAM

Hall very fine sandy loam differs from Hall silt loam principally in the higher content of very fine sand in its upper layers. The lower subsoil layer and the underlying parent material are similar to those of Hall silt loam. The soil has weathered from alluvial material, chiefly of loessial origin, deposited when the streams were flowing at higher levels. The sand in the surface soil has been carried in from near-by more sandy soils by wind and water.

Hall very fine sandy loam occurs in large and small bodies throughout the larger stream valleys. It is well developed in South Loup River, Wood River, Mud Creek, and Middle Loup River Valleys, and narrow strips occur along many of the smaller drainage ways. The areas are flat or gently undulating, having a gentle slope toward the streams and down the valleys. The soil lies from 8 to 30 feet above the first bottoms and is well drained.

Hall very fine sandy loam is naturally strong and fertile, equaling Hall silt loam in productiveness. It will withstand considerable abuse without great decrease in crop yields. All the land, except small bodies included in farmsteads, pastures for farm animals, and narrow strips along the highways, is under cultivation, mainly to corn and alfalfa. During exceptionally favorable years four cuttings of alfalfa are made.

HALL FINE SANDY LOAM

Hall fine sandy loam differs from Hall very fine sandy loam principally in its higher content of fine sand in the upper layers. The lower layers are very similar to corresponding layers of the very fine sandy loam and silt loam members of the Hall series.

In many places around the margins of the areas the soil merges with Hall very fine sandy loam, and in a few places the surface material contains so much sand as to approach sandy loam in texture. In the last-mentioned localities the upper subsoil layers contain an unusually large quantity of sand, and the lime zone, which is seldom present above a depth of 4½ feet, in many places contains scattered irregular, though more or less rounded, rocklike concretions of lime, from one-eighth to one-fourth inch in diameter, in addition to numerous streaks, seams, and splotches of this material. Here the soil appears to have been leached of its lime to a slightly greater depth than the typical soil, probably owing to its coarser texture and greater porosity. Many areas in which the texture approaches sandy loam occur in fairly large bodies throughout the northern and western parts of the county.

Hall fine sandy loam occurs in scattered bodies within the Middle Loup River, South Loup River, and Victoria Creek Valleys. Some of the largest areas are in the vicinity of Sargent, Callaway, and Finchville.

Owing to its rather small extent Hall fine sandy loam is not an important farming soil in Custer County. It is well adapted to all the common crops, however, and yields of corn and alfalfa are as high as on any other terrace soil. Small-grain yields probably average a trifle lower than those obtained on Hall silt loam, but most farmers recognize little difference in the producing power of any of the Hall soils.

HALL SILTY CLAY LOAM

The A_1 horizon of Hall silty clay loam consists of a thin surface mulch of dark grayish-brown mellow silt loam, seldom exceeding an inch in thickness, in which there is no definite grouping or arrangement of the soil particles. This layer is underlain by the A_2 horizon consisting of about 4 inches of very dark grayish-brown or almost black silty clay loam in which the particles are grouped in such a way as to produce a laminated or platy structure. The plates are

from one thirty-second to one-sixteenth inch thick, about one-half inch in diameter, and overlap one another, producing a somewhat shingled effect. The material of this layer breaks down into fine granules most of which are irregular in shape and about one-eighth inch in diameter. However, the presence of numerous thin flakes and flattened granules indicates that the material tends to break along its structural planes. The next layer is the upper subsoil, or B_1, horizon which lies between the average depths of 5 and 15 inches and consists of dark grayish-brown very finely granular silty clay loam, containing a little more clay than the layer above, but lacking any trace of the platy or laminated structure. This horizon is underlain by the zone of maximum compaction, or B_2 horizon, which is only slightly lighter in color but decidedly denser than the layer above. It has received much fine material from the surface and upper subsoil horizons and consists of moderately compact grayish-brown silty clay which breaks into a coarsely granular or small cloddy mass, the lumps ranging from one-fourth to about three-fourths inch in diameter. The lumps are very firmly cemented and are difficult to reduce between the fingers. At a depth of about 2 feet the horizon gives way abruptly to a light grayish-brown loose floury silt layer in which occur imperfectly developed vertical checks or cracks similar to those so characteristic of loessial deposits. This is the third layer of the subsoil, or the B_3 horizon. It merges gradually at a depth of about 45 inches with the B_4 horizon, or zone of maximum carbonate accumulation, which is similar in texture and structure to the layer above, but most of the lime from the overlying horizons has accumulated in the seams, checks, and cracks of this layer resulting in a spotted or mottled gray and white appearance. The parent material, a light-gray or almost white highly calcareous silt or alluvial loam, lies at a depth of about 5 feet and continues uniform throughout the remainder of the loessial deposit. The lime of this layer is thoroughly mixed with the silt, and no spots of unusual concentration, as in the layer above, occur.

Hall silty clay loam has been derived in the same manner as other members of the Hall series. The larger clay content of its surface horizons is probably owing to its lower position, which has favored the accumulation of the finer materials from the higher-lying soils. Most of the soil occupies the flatter and lower-lying land within areas of Hall silt loam or Hall very fine sandy loam. Natural surface drainage is poor, but the subsoil usually absorbs the moderate rainfall of the region, and water seldom remains on the surface longer than a few hours. Only a few of the bodies require artificial drainage.

Areas of Hall silty clay loam occur in a few scattered bodies in the eastern and southeastern parts of the county on the terraces bordering Mud and Clear Creeks. One of the largest areas, comprising about 800 acres, is along Clear Creek about 3 miles southeast of Westerville. Another large body borders the same stream south of Deem School in Myrtle Township.

About 90 per cent of the land is under cultivation, and most of the remainder is included in small farm pastures. All crops grown in the county do exceptionally well on this soil. Yields are, in general, a trifle higher than those obtained on Hall silt loam and Hall very fine sandy loam, as the moisture supply is more favorable.

However, this soil, owing to its large clay content, is more difficult to handle than other Hall soils. It is very difficult to plow when dry, and if plowed when wet clods are formed which require subsequent wetting and drying or freezing and thawing before granulation is restored. The land, however, works easily if handled under favorable moisture conditions.

TRIPP VERY FINE SANDY LOAM

The A, or surface, horizon in virgin areas of Tripp very fine sandy loam is grayish-brown or dark grayish-brown friable very fine sandy loam from 3 to 7 inches thick. The structure in most areas ranges from single grain to very finely granular. Throughout much of the soil, however, the soil particles are grouped in such a way as to produce a platy or laminated structure somewhat similar to, although not so well developed, as in the A_2, or subsurface, horizon of Hall very fine sandy loam. The upper subsoil, or B_1, horizon is gray or light-gray very fine sandy loam which is slightly more compact than the layer above owing to a larger silt and clay content and a lower organic-matter content. The structure ranges from coarse granular to small cloddy. This layer extends to an average depth of 14 inches, where it changes rather abruptly to very light-gray or almost white loose floury silt having no definite structure. In exposed cuts the light-gray material appears massive, and a lump when removed and dropped breaks into clods of various sizes and shapes together with considerable loose floury silt. This layer, which is the B_2, or second subsoil, horizon, ranges in thickness from 8 to 14 inches, and it is underlain at a depth ranging from 26 to 30 inches by the B_3 horizon, or zone of maximum carbonate accumulation. This horizon is similar in texture and structure to the layer above but contains numerous streaks, specks, splotches, and fine winding threads of white lime, which give the material a mottled light-gray and white appearance. The next layer, which is present in most areas at a depth of about 36 or 40 inches, is the parent material, or C horizon. It is loose floury and limy silt similar to that which underlies the Hall soils. It contains no spots of lime concentration as does the layer above. The surface soil contains considerable organic matter, but this material is never so abundant nor does it extend so deep as in the associated Hall soils.

This soil has weathered from alluvial materials deposited by streams when they were flowing at higher levels. Later intrenchments have left these deposits as terraces or benches now lying from 10 to 15 feet above the present channels. The lighter color and lower organic-matter content of the surface horizon indicate that either the deposits giving rise to this soil are more recent than those giving rise to the Hall soils or conditions have been less favorable for the growth and decay of plant life.

In a few places the subsoil contains no zone of excessive lime accumulation. In such localities the parent loess usually lies within 2½ or 3 feet of the surface and merges so gradually with the B_2, or second subsoil, horizon that the line of separation can be determined only by the use of acid, the B_2 horizon containing insufficient lime to react.

Tripp very fine sandy loam occurs chiefly in Cliff and Kilfoil Townships where it occupies both large and small bodies northwest of Merna and throughout the eastern part of Ortello Valley. Smaller areas lie both north and south of Merna.

Areas of this soil are flat or very gently undulating. The surface slopes gently down the valleys and toward the stream channels. The slight slope, together with the porosity of the soil and subsoil, affords ample drainage, but the soil is not subject to stream erosion. It is retentive of moisture.

Owing to its small extent, this soil is not important in the agriculture of Custer County. It is very fertile, however, and although not quite so strong and enduring as the Hall soils, on account of its slightly lower organic-matter content, it produces yields comparing very favorably with those obtained on the best upland and terrace soils of the county. Practically all the land is under cultivation, chiefly to corn, wheat, alfalfa, oats, and rye. The soil is handled in the same manner as the Hall soils.

SIOUX FINE SANDY LOAM

Sioux fine sandy loam in virgin areas consists of the following layers: (1) From 6 to 10 inches, very dark grayish-brown friable pulverulent fine sandy loam; (2) grayish-brown slightly compact very fine sandy loam of finely granular structure about 5 inches thick; (3) a 10 or 12 inch layer of material similar in texture and structure to the layer above but lighter in color, more friable, and containing an abundance of lime; (4) a 2-foot layer of light-gray fine sand which is faintly coherent when moist; and (5) very light-gray loose incoherent fine or medium sand which remains uniform to a depth extending below 8 or 10 feet.

The first layer is the surface soil, or A horizon. It is rich in organic matter, as the color indicates, but has no definite structure or grouping of the individual soil particles. The second layer is the upper subsoil, or B_1, horizon. It has received considerable fine material, probably washed down from the layer above, and this has caused the slight compaction and finely granular structure. The small granules have irregular angular shapes and range in diameter from one-sixteenth to about one-eighth inch. The third layer is the B_2, or carbonate, zone. The lime of this zone usually occurs in finely divided form thoroughly mixed with the soil, but it may accumulate as numerous specks, seams, and splotches, giving the horizon a mottled gray and white appearance. The fourth, or B_3, layer is composed largely of sand, though it may contain faint traces of lime and barely sufficient silt in the upper part to give the material slight coherence when moist. Both lime and silt gradually decrease with depth, and the horizon merges at a depth of about 3 feet with the incoherent noncalcareous almost pure sand of the parent material.

The soil has weathered from sandy sediments originally deposited in old flood plains which, owing to later stream intrenchment, now occupy terrace or bench positions.

Areas of this soil vary somewhat in the texture, thickness, and depth of the different horizons. The principal surface variations are toward very fine sandy loam and loamy fine sand, and small

bodies having such textures are included with the typical soil in mapping. Locally the material below a depth of 30 inches is loose porous gravelly sand. This soil differs from soils of the O'Neill series chiefly in the larger lime content of its subsoil.

Sioux fine sandy loam occurs in small scattered bodies and narrow strips on the Middle Loup River, South Loup River, and Mud Creek terraces.

Most areas of this soil are flat, modified by low rounded knobs and shallow depressions. The surface lies somewhat below that of the adjoining terrace soils, and in wet years the land is rather poorly drained owing to the accumulation of water from the higher levels. The porous subsoil, however, speedily absorbs the surplus moisture so that water seldom remains on the surface longer than a few hours. The soil does not have a high water-retaining power, and in dry years crops sometimes suffer from lack of moisture.

Owing to its small extent and uncertain drainage, Sioux fine sandy loam is of little agricultural importance. The relief is favorable to cultivation and practically all the land is used for crop production, mainly corn and alfalfa. Under favorable moisture conditions, crop yields compare very favorably with those on the Hall soils. In dry years, however, yields of corn especially are low. On account of the high lime content, alfalfa flourishes on this soil.

BRIDGEPORT FINE SANDY LOAM

In virgin areas the surface soil of Bridgeport fine sandy loam is grayish-brown loose incoherent fine sandy loam or loamy fine sand 8 or 10 inches thick. The subsoil in most places differs little in texture and structure from the surface soil, but it is lighter in color, being light-gray or gray loamy sand. It merges so gradually with the underlying parent material and the two are so similar in texture, structure, and color that the line of separation is difficult to determine. Below a depth of 4 or 5 feet, however, the material consists of loose incoherent fine or medium sand, which remains uniform to a great depth except where locally modified by an admixture of considerable coarse sand and fine gravel. The material contains sufficient lime to react with dilute hydrochloric acid below an average depth of 18 inches. The lime is in finely divided form thoroughly mixed with the soil, and no spots of unusual concentration occur.

About 30 per cent of the material mapped as Bridgeport fine sandy loam has reached a slightly more advanced stage of soil development than the remainder, and the A, B, and C horizons, or surface soil, subsoil, and parent material layers, are more pronounced and more readily distinguished. The surface soil, or A horizon, differs little in character or depth from the typical soil. The subsoil, however, has two more or less imperfectly developed layers. The upper, or B_1, horizon contains considerable silt and clay and consists of light grayish-brown friable though coherent very fine sandy loam of fine or very finely granular structure. It continues to an average depth of about 18 inches where it merges with the lower layer, or B_2 horizon. This is a looser and slightly lighter-colored material, though it differs little in texture from the layer above. It rests on the parent sand at a depth of about 4 feet.

The origin of this soil is difficult to determine. It has weathered from a mixture of sand and silt probably derived from the near-by loessial deposits or Valentine areas and was carried to its present position partly as colluvial material from the higher slopes and partly as sediment from the streams when they were flowing at higher levels. Wind action has also assisted in its formation.

Bridgeport fine sandy loam occurs in various-sized bodies on the terraces of South Loup and Middle Loup Rivers and Mud Creek. The largest area, comprising about 800 acres, is west of Ernst in the central part of the county.

Areas of this soil range from nearly level to hummocky. Most of the land is characterized by low rounded ridges and hummocks separated by small lower-lying depressions of almost level land. Drainage is thorough throughout. Surface channels are poorly developed but the porous subsoil affords ample, and in places excessive, underdrainage. The soil is not very retentive of moisture, as most of the water sinks into the loose sand and is carried away through subterranean channels.

About 50 per cent of the soil is under cultivation mainly to corn and alfalfa, and the remainder is used for pasture and hay land. The native vegetation consists of the same grasses as grow on the Valentine soils, with a slightly larger proportion of grama grass. Crop yields are seldom as high as on the finer-textured upland and terrace soils of the county.

O'NEILL LOAMY SAND

The surface soil of O'Neill loamy sand, to an average depth of 8 inches, is a very dark grayish-brown loose incoherent mixture of the various grades of sand, the fine and medium grades predominating. Its color indicates that it is rich in organic matter. The subsoil is lighter in color and finer in texture than the surface soil. It consists of light grayish-brown fine sandy loam or very fine sandy loam, which contains sufficient silt, probably washed down from the layer above, to loosely bind the sand grains together and give the material slight coherence and a coarsely granular or nutlike structure. The small lumps, however, remain friable and are easily reduced between the fingers. This horizon becomes gradually lighter in color and coarser with depth, merging at a depth of about 2 feet with very light-gray incoherent fine or medium sand which has been little affected by weathering, contains practically no organic matter, and continues uniform below a depth of 6 or 8 feet. The soil is very low in lime.

The soil has weathered from coarse alluvial sediments deposited when the streams were flowing at higher levels. Later stream intrenchment left the deposits as terraces above the present flood plains. Surface wash from the adjoining uplands and wind-blown materials from the surrounding soils have further contributed to its formation.

O'Neill loamy sand occurs in scattered bodies on terraces of Middle Loup and South Loup Rivers throughout their distance across the county. Only a few of the bodies exceed 360 acres. Some of those on South Loup River in the vicinity of Arnold occupy more than 1 square mile each.

In general, areas of this soil are flat or slightly undulating. In some areas the surface has been modified by wind action and the land is hummocky. Owing to the porosity of the subsoil, drainage is thorough throughout and in many places is excessive.

About 70 per cent of the land of this kind is cultivated and the remainder is used for grazing purposes and hay production. The native vegetation consists of many nutritious grasses chief among which are big bluestem, little bluestem, sand grass, and stipa or needle grass. Corn is the dominant crop on the cultivated areas. Small fields of alfalfa, wheat, oats, and rye are grown on many farms. Alfalfa is usually cut twice during the summer.

O'NEILL FINE SANDY LOAM

The texture of the surface soil of O'Neill fine sandy loam ranges from fine sandy loam to sandy loam. The lower layers are very similar to the corresponding layers of O'Neill loamy sand.

O'Neill fine sandy loam occurs in a few small bodies in the South Loup and Middle Loup River Valleys and south of Anselmo in Victoria Creek Valley. One of the largest areas, comprising about 360 acres, is east of Sargent in the northeastern part of the county.

Areas of this soil are flat or very gently undulating. Owing to the looseness and porosity of the subsoil and parent material, drainage is good and in many places excessive. The soil is not retentive of moisture, and crops sometimes suffer during droughts. The relief, however, is favorable to cultivation, and about 80 per cent of the land is used in the production of corn, alfalfa, wheat, and oats; the remainder is included in pasture and hay land.

O'NEILL VERY FINE SANDY LOAM

O'Neill very fine sandy loam has been separated from O'Neill fine sandy loam principally on the basis of the finer sand content of its surface soil. In all other respects the two soils do not materially differ.

In a few included areas the soil consists of loose incoherent fine or medium gray sand which remains uniform to a great depth except that the 6 or 8 inch surface layer has become very dark grayish brown or almost black owing to the accumulation of large amounts of organic matter. In a few other areas the parent material becomes gradually coarser with depth and below a depth of 3 feet consists largely of coarse sand and fine gravel.

This soil has developed on terraces well above present overflow. It has weathered in the same manner as other members of the O'Neill series but evidently from finer sands.

O'Neill very fine sandy loam occurs in a few small bodies chiefly in the valleys of Middle Loup River and Victoria Creek. One of the largest areas, comprising about 180 acres, is 2 miles west of Gates in Lillian Township.

Areas of this soil, which are almost flat, slope gently toward stream channels and down valleys. The soil is somewhat droughty owing to its looseness and sandiness, and crops sometimes suffer during prolonged dry spells. However, it is more retentive of moisture than the coarser-textured O'Neill soils, and practically all the land

is under cultivation. All crops common to the region are grown. During years of high rainfall yields compare very favorably with those obtained on the Hall soils, but in average years they are about one-fifth lower.

CASS FINE SANDY LOAM

In virgin areas of Cass fine sandy loam the surface soil is very dark grayish-brown fine sandy loam from 6 to 10 inches deep. The subsoil varies considerably, but it is usually grayish-brown incoherent loamy sand in the upper part. It becomes gradually lighter in color and coarser in texture with depth, merging at a depth of 24 inches with a loose porous mass of light-gray coarse and medium sand which continues uniform below a depth of 4 or 5 feet. In many areas of this soil, the upper 6 or 8 inch layer of the subsoil contains an unusually large amount of silt and clay, owing either to the translocation of the finer surface particles or to the character of the sediment at the time of its deposition, and it consists of light grayish-brown friable sandy clay loam, which has a sticky gritty feel when wet and breaks into small irregular clods when dry. The lumps, which are of various sizes, averaging about one-half inch in diameter, are very friable, and can readily be crushed between the fingers. This layer rests directly on the light-gray incoherent coarse or medium sand of the lower subsoil layer and substratum. Both surface soil and the upper part of the subsoil have a high lime content, but the remainder of the soil seldom contains sufficient lime to give a noticeable reaction when acid is applied.

Cass fine sandy loam is developed on sandy alluvial material deposited in the flood plains of streams during comparatively recent times. Weathering and the accumulation of large amounts of organic matter in the upper part of the deposit have created the present soil.

This soil occurs in scattered bodies on the bottom lands along Middle Loup and South Loup Rivers. The largest areas are south of Comstock on each side of Middle Loup River.

Areas of this soil are generally flat, modified in places by slight elevations, shallow depressions, and old stream channels. They lie only a few feet above the normal flow of the streams and in places are subject to overflow during periods of high water. In wet years the water level comes to within 3 feet of the surface in some places, and parts of the soil remain too moist for profitable farming. In very dry years underdrainage is excessive, and crops do not do so well as on soils with heavier subsoils.

Owing to its small extent and uncertain drainage this is not an important agricultural soil in Custer County. Only about 60 per cent of it is under cultivation, chiefly to corn and alfalfa, and the remainder is used for hay and pasture land. The soil is not so well adapted to small grain on account of the difficulty of preparing a firm, compact, seed bed.

The native vegetation consists of a rather rank growth of prairie and marsh grasses, and will support one cow or horse to the acre during the summer grazing season, or when cut for hay will yield from three-fourths to 1 ton.

CASS VERY FINE SANDY LOAM

The surface soil of Cass very fine sandy loam is dark grayish-brown or black very fine sandy loam from 4 to 10 inches deep. It contains considerable silt and only a small proportion of particles coarser than fine sand. The soil is very rich in well-decomposed organic matter which in places becomes so abundant as to give the materials a rather spongy consistence and noticeably light texture. The subsoil contains less organic matter and more sand than the surface layer. In many places it consists of grayish-brown loamy sand which becomes gradually lighter in color and looser with depth until light-gray almost pure medium sand is reached at a depth of about 30 inches. This usually continues uniform below a depth of 6 or 8 feet. Both soil and subsoil vary widely in texture in different places. The surface soil and upper subsoil layers are highly calcareous, but the remainder of the soil is very low in lime. The organic matter, so abundant in the surface horizon, decreases rapidly with depth, and only slight traces occur below a depth of 18 or 20 inches.

This soil has weathered from sandy alluvial materials deposited in the bottom lands along streams during periods of high water. The high organic-matter content of the surface soil is owing to the growth and decay of vegetation since deposition.

Cass very fine sandy loam occurs in scattered bodies on the Middle Loup and South Loup River bottoms. The land is prevailingly flat except where relieved by old stream channels, cut-offs, and low mounds or ridges.

Corn or truck crops are grown on a few of the higher-lying and better-drained areas, but practically all the land is used for grazing and hay purposes. The native vegetation consists largely of prairie and marsh grasses which will support one cow or horse to the acre during the summer grazing season or when cut for hay will yield 1 or 1¼ tons. Narrow strips of scrub willow, ash, elm, and boxelder border a few of the stream channels.

CASS LOAMY SAND

Cass loamy sand is similar to other Cass soils except in texture. It contains more fine sand and less silt and clay than the sandy loams. It contains sufficient finer materials, however, to give it a loamy texture and slight coherence. This soil has developed from sandy alluvium of recent origin, lying on the present flood plains. Wind-blown sands from the stream channels have also contributed largely to its formation.

Cass loamy sand occurs in numerous bodies and narrow strips on the bottom lands of Middle Loup and South Loup Rivers throughout their distance across the county.

In general, the surface is flat, but it is modified by many depressions, dry channels, old cut-offs, and slight elevations, and drainage is variable. As much of the soil lies but a few feet above normal stream flow, in wet seasons the underlying water table rises too near the surface for profitable farming. In dry years the underdrainage in places is excessive, and crops often suffer from lack of moisture. During normal seasons, however, over a large part of the land moisture conditions are favorable for crops. About 60 per cent of the

land is farmed, and the rest is used for grazing purposes and hay land.

Corn is the chief cultivated crop. Some sweetclover and alfalfa are grown, but the land is not well adapted to either of these crops or to small grain on account of the difficulty of obtaining a sufficiently compact seed bed and the danger of injury to young plants through soil drifting.

The native vegetation, consisting largely of sand grass, bluestem, and stipa or needle grass, will support from 80 to 100 head of cattle to the quarter section during the summer grazing season or when cut for hay will yield from one-half to three-fourths ton to the acre.

SARPY SAND

In virgin areas of Sarpy sand the surface soil consists of gray or grayish-brown loose incoherent fine or medium sand to a depth ranging from 12 to 15 inches. This is underlain by material of similar structure and consistence though slightly coarser texture ranging in depth from 4 to 5 or more feet. The 1 or 2 inch surface layer usually contains considerable organic matter and in many places is much darker than the rest of the soil. The humus content, however, is insufficient to prevent soil drifting when the native vegetation is destroyed, and it rapidly disappears if the land is overgrazed or brought under cultivation. This soil is not calcareous.

As mapped, Sarpy sand includes several variations. The differences from the typical soil consist chiefly in the content of organic matter in the surface soil and the relative proportion of the different grades of sand throughout the soil. In a few of the lower-lying and more protected areas the organic matter in the surface soil is so abundant as to create a loamy sand texture. On the tops of the low rounded knolls and ridges, throughout cultivated fields or wherever the native vegetation is either destroyed or unusually sparse, wind action has removed practically all the organic matter, leaving the surface material an almost pure gray sand. South of Comstock, on the east side of Middle Loup River are a few small included bodies in which an unusually large amount of coarse sand and gravel is scattered over the surface and throughout the soil. The surface soil in these bodies is gravelly sandy loam. In a few areas the material below a depth of 30 inches is mottled with rust-colored iron stains, indicating poor drainage.

The soil has weathered on recent sandy alluvium. It is not old enough to have developed a dark-colored surface horizon through the growth and decay of vegetation. In many places it resembles river wash but is more stable and not so greatly influenced by each slight rise of the stream.

Sarpy sand occurs in scattered bodies and narrow broken strips along the channels and throughout the bottom lands of Middle Loup and South Loup Rivers. The land is flat, modified in places by old cut-offs, depressions, and slight elevations, the last-named being caused by wind, which in the more exposed situations whips the sand into low rounded knolls and ridges. Areas of this soil lie from 2 to 6 feet above normal stream flow, and much of the land is subject to occasional inundation. In dry years internal drainage is excessive and

even the native vegetation suffers from lack of moisture. In wet years, however, the water table lies within a depth of 3 feet from the surface in many places, and in the lower-lying situations water sometimes accumulates on the surface, thus creating small areas of marshy land.

Practically all the Sarpy sand is included in pasture and hay land. Some corn is grown on a few acres, but yields are low except in the most favorable years. The native vegetation is sparse, and the land does not have a high value even for grazing.

SARPY GRAVELLY SAND

Sarpy gravelly sand consists of a loose incoherent mixture of fine sand, medium sand, and fine gravel to a depth below 4 feet. The 5 or 6 inch surface layer contains some organic matter and is usually grayish brown, but the remainder of the soil contains practically no humus and is light grayish brown or very light gray.

Sarp gravelly sand occurs chiefly in a single body, comprising about 600 acres, on the east side of Middle Loup River south of Comstock. The soil has weathered in the same manner as Sarpy sand but evidently from coarser alluvial deposits.

The land is flat with a gentle slope down the valley and toward the stream channel. Underdrainage is excessive. The soil lies from 6 to 8 feet above normal stream flow and is not subject to inundation. The loose, porous subsoil absorbs and carries off the slight rainfall through subterranean channels, and the soil is very droughty.

All this soil is included in pasture and hay land. It supports a rather sparse growth of grasses which afford fair pasture during the spring and early summer but which usually wither by midsummer and can not be depended on for late grazing.

LAMOURE VERY FINE SANDY LOAM

Lamoure very fine sandy loam to a depth of about 30 inches consists of a black friable mixture of very fine sand, silt, clay, and organic matter. Below this depth is light-gray silty clay which continues throughout the rest of the soil. The surface layer to a depth of about 6 inches contains a comparatively large proportion of very fine sand but little coarser-textured material. The structure is finely granular, and when dry the material breaks into small irregular-shaped granules averaging about one-fourth inch in diameter. The remainder of the black horizon is finer in texture, containing less very fine sand and more silt. There is no definite grouping or arrangement of the soil particles as in the surface layer, but the material consists of structureless silt loam or silty very fine sandy loam. The high silt and organic-matter content give the soil material considerable coherence, but it remains friable and can be readily crushed between the fingers even when dry. The lower subsoil layer, or light-gray horizon, is very low in organic matter and consists largely of silt and clay. It has a smooth waxy feel when wet but becomes extremely hard and tough on drying. The surface layer has a high lime content, and the lower subsoil layer is faintly calcareous, but the intermediate structureless layer does not contain sufficient lime to react when acid is applied.

Lamoure very fine sandy loam occurs only in a few small bodies on the bottom lands of South Loup River between Callaway and the western county line. The total area is less than 1 square mile.

Owing to its small extent and poor drainage, the soil is not used for crop production but is all included in pasture and hay land. The native vegetation is composed largely of coarse marsh grasses, together with sedges and reeds in the more poorly drained places. The hay is coarser and has a lower feeding value than that obtained on the better-drained soils, but the larger yields tend in a measure to offset the quality.

The urgent need of this soil is artificial drainage. A system of deep ditches or tiling would greatly increase its producing power.

RIVER WASH

Nearly all the material mapped as river wash occurs on small islands, ranging in size from a few square rods to about 5 acres and locally known as towheads, within the channel of Middle Loup River.

River wash is not a soil. It is simply a recent sandy deposit which undergoes change with each slight rise of the stream. Even during normal flow small areas are shifted about, added to, or removed by the changing current. The material differs from Sarpy sand in its less stable nature and the almost total absence of organic matter. In many places the sandy deposits are sufficiently pure to be used in construction work.

River wash represents the first stages of alluvial soil formation and with the accumulation of organic matter under undisturbed conditions of weathering will gradually develop into Sarpy sand.

DUNE SAND

Dune sand consists of gray, grayish-yellow, or grayish-brown smooth incoherent fine sand or medium sand which extends to a depth of more than 6 feet with little change in texture. The 4 or 5 inch surface layer contains some organic matter, but not enough to prevent drifting when the covering of grasses is removed. The soil is fairly retentive of moisture considering its loose consistence. It is not calcareous.

There is little variation in dune sand throughout Custer County, except locally where the material contains more silt, clay, and organic matter than usual, owing probably to more favorable conditions for weathering and for the growth and decay of plant life. The loamier areas have a thicker grass covering than most of the material and therefore a higher grazing value.

Dune sand has been derived from sandy tertiary strata and deposited in its present position by the wind. The general absence of fine material is probably owing to its removal by the wind during the continual shifting of the dunes. The surface is sharply rolling or hilly. The dunes range in height from 20 to 50 feet. Blow-outs are of frequent occurrence. The material contains less organic matter, is less stable, and has a lower grazing value than Valentine sand. At present a negligible part of the land is subject to active wind erosion. Few continuous waterways flow through dune sand, but owing to the looseness and porosity of the substratum,

all the rainfall is absorbed, and there is seldom any run-off even on the steeper slopes.

Dune sand occupies a large part of Custer County, occurring chiefly in the northwestern corner where it is the dominant material throughout several townships. An extensive area lies east of Talline Table in the west-central part of the county, and small bodies are west of Broken Bow in the central part.

Dune sand is of little value for farming as destruction of the native sod is followed by damaging wind erosion. Nevertheless, a few patches here and there are in cultivation, mainly to corn, the yield of which is poor, especially after the first year. Generally, the fields are soon abandoned. Practically all the dune sand areas are in pasture land, though some hay is cut in the smoother areas. The native vegetation includes a great number of grasses of which long-leaf reed grass, redfieldia, and stipa are the most common. Dune sand is capable of maintaining from 80 to 100 head of livestock to the square mile during the summer grazing season. As dune sand is incoherent no attempt should be made to use the land for crop production.

SUMMARY

Custer County is in the central part of Nebraska. It is rectangular in shape and contains 2,588 square miles, or 1,656,320 acres. It occupies parts of the loess hills and the sand-hill regions of the State. Though not conspicuous, considerable relief has been produced by stream and wind erosion, and the surface of the uplands ranges from rough and broken to almost flat. The flatter areas occupy the table-lands and broader divides in that part of the county where the original constructional plain terraces and flood plains are flat or gently undulating.

The average elevation of the county is about 2,400 feet above sea level. The general slope is to the southeast. Drainage is effected chiefly through Middle Loup and South Loup Rivers, and most of the land is well drained.

The first permanent settlements in the area which is now included in Custer County were made in 1873 and 1874, and the county was established in 1877. The population in 1920 was 26,407. Broken Bow, the county seat and only city, had, in that year, 2,567 inhabitants.

The county has fair transportation facilities.

The climate is well suited to the production of hay and grain crops and the raising of livestock. The mean annual precipitation is 24.05 inches, and the mean annual temperature is 48.2° F. The average frost-free season is 148 days. The proportion of clear sunshiny days is relatively high.

The agriculture of the county consists of the raising of livestock and the production of grain and hay crops. The more nearly level hard-land sections of the county are used chiefly for diversified farming and the rougher and more sandy parts for pasture and hay land. The chief crops are corn, wheat, oats, alfalfa, rye, and prairie hay. Most of the cattle are of the Hereford or Shorthorn breeds. Hogs are raised on every farm capable of producing corn and alfalfa. The farms, as a rule, are well improved, and modern labor-saving machinery is in general use.

The soils of Custer County have been developed under climatic and vegetative environments which are transitional between those of eastern and western Nebraska. The grassy vegetation, which through decomposition has given the carbonaceous material and dark color to the surface soils, is less abundant than in eastern Nebraska but more plentiful than in the western part of the State. The rainfall, soil textures being similar, has not been sufficient to entirely leach the lime from the soil as in eastern Nebraska. The carbonates have been deposited in the well-developed soils forming a layer of higher lime content than in the layers either above or below. This layer, however, lies slightly deeper than the corresponding layer in the soils of western Nebraska.

The soils of Custer County are grouped in 14 soil series, including 32 soil types and 5 phases of types, in addition to the miscellaneous materials, dune sand and river wash.

Holdrege silt loam and Holdrege very fine sandy loam are among the strongest and most fertile upland soils of the county. They occupy the table-lands and broader divides within areas of the Colby soils and have developed darker and deeper surface horizons than those soils.

Colby silt loam, together with its broken phase, is the most extensive soil in the county and occurs in all parts except the northwestern. The typical soil is adapted to all crops common to the region, and the broken phase is used chiefly for grazing purposes.

The Valentine soils are developed chiefly in the northwestern and west-central parts of the county. They have weathered from sandy deposits and are rather unstable. Much of the land is used for pasture and hay production although corn is an important crop in the more stable areas.

Soils of the Anselmo series occur chiefly in the north-central and west-central parts of the county. They differ from the Valentine soils in that they have developed a layered or zonal profile, contain more silt, and are more coherent throughout the surface and subsoil horizons.

Sioux fine sandy loam differs from soils of the Valentine series chiefly in the finer texture and darker color of its surface soil and large lime content of its subsoil.

The O'Neill soils differ from the Sioux soils in the lower lime content of their subsoils and from the Valentine soils in the darker color and higher organic-matter content of their surface layers.

Bridgeport fine sandy loam occurs on the terraces of South Loup and Middle Loup Rivers and Mud Creek. It has not developed such a definite profile or zonal arrangement as have the O'Neill and Sioux soils. This soil differs from the Valentine soils chiefly in its higher lime content.

Hall silt loam and Hall very fine sandy loam are among the most productive soils in Custer County. They have developed dark-colored surface horizons and highly calcareous subsoils. The subsoils are silty and coherent in contrast to the loose sandy materials underlying the Sioux, O'Neill, and Valentine soils.

Tripp very fine sandy loam occurs chiefly in the central and east-central parts of the county where it occupies terraces along streams. The soil resembles Hall very fine sandy loam except in the lower organic-matter content and lighter color of its surface layer.

Gannett loamy sand is very inextensive. It occupies the wet valleys within the sand-hill region and is used for grazing purposes and hay production.

Scott silty clay loam occurs in small circular depressions, locally known as lagoons or buffalo wallows, throughout the hard uplands and heavier-textured terrace soils. On account of its poor drainage this soil is seldom used for crop production.

The Cass, Sarpy, and Lamoure soils occupy bottom-land positions along streams and are in places subject to overflow during periods of high water. The first two soils have loose sandy and gravelly subsoils, and the subsoil of the Lamoure soil is composed of silt and clays. The Cass and Lamoure soils have developed dark-colored surface layers, but the Sarpy soils are low in organic matter and light in color.

Dune sand and river wash are miscellaneous materials not classed with any soil series. Both dune sand and river wash are low in organic matter and are composed almost entirely of sand. Dune sand occupies extensive areas chiefly in the northwestern part of the county, and river wash occurs in a few small islands within the channel of Middle Loup River.

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[PUBLIC RESOLUTION—No. 9]

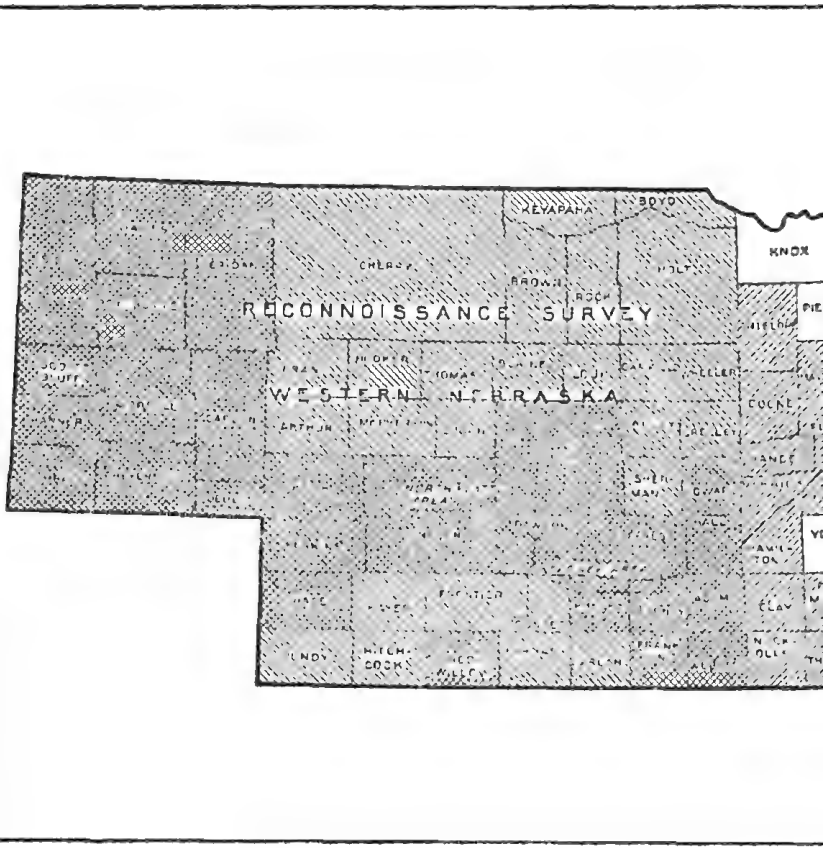
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled. That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Nebraska, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1931

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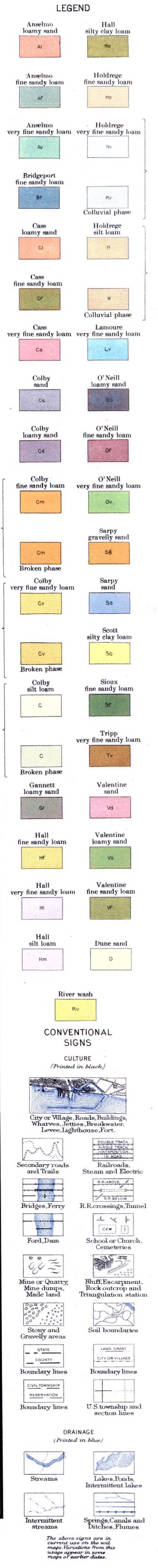
U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
HENRY G. KNIGHT, CHIEF
A. G. McCALL, CHIEF, SOIL INVESTIGATIONS
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP

CUSTER COUNTY—NORTHERN SHEET
NEBRASKA

UNIVERSITY OF NEBRASKA
STATE SOIL SURVEY DEPARTMENT OF THE
CONSERVATION AND SURVEY DIVISION
G. E. CONDRA, DIRECTOR


LEGEND
Anselmo loamy sand
Hall silty clay loam
Anselmo fine sandy loam
Holdrege fine sandy loam
Anselmo very fine sandy loam
Holdrege very fine sandy loam
Bridgeport fine sandy loam
Colluvial phase
Cass loamy sand
Holdrege silt loam
Cass fine sandy loam
Colluvial phase
Cass very fine sandy loam
Lamoure very fine sandy loam
Colby sand
O'Neill loamy sand
Colby loamy sand
O'Neill fine sandy loam
Colby fine sandy loam
O'Neill very fine sandy loam
Broken phase
Sarpy gravelly sand
Colby very fine sandy loam
Sarpy sand
Broken phase
Scott silty clay loam
Colby silt loam
Sioux fine sandy loam
Broken phase
Tripp very fine sandy loam
Gannett loamy sand
Valentine sand
Hall fine sandy loam
Valentine loamy sand
Hall very fine sandy loam
Valentine fine sandy loam
Hall silt loam
Dune sand
River wash
CONVENTIONAL SIGNS
CULTURE
(Printed in black)
DRAINAGE
(Printed in blue)
Streams
Lakes, Ponds, Intermittent lakes
Intermittent streams
Springs, Canals and Ditches, Flumes
The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Thomas D. Rice, Inspector, District 3.
Soils surveyed by F. A. Hayes, in charge, and M. H. Layton, U. S. Department of Agriculture and E. A. Nieschmidt, C. H. Hayes, A. N. Huddleston and S. S. Diedrichs, Nebraska Soil Survey.

Scale 1 inch=1 mile

Field Operations
Bureau of Soils
1926

U. S. DEPARTMENT OF AGRICULTURE
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HENRY G. KNIGHT, CHIEF
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CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP

CUSTER COUNTY–SOUTHERN SHEET
NEBRASKA

UNIVERSITY OF NEBRASKA
STATE SOIL SURVEY DEPARTMENT OF THE
CONSERVATION AND SURVEY DIVISION
G. E. CONDRA, DIRECTOR

LEGEND
Anselmo loamy sand Al
Anselmo fine sandy loam Af
Anselmo very fine sandy loam Av
Bridgeport fine sandy loam Bf
Cass loamy sand Cl
Cass fine sandy loam Cf
Cass very fine sandy loam Ca
Colby sand Cs
Colby loamy sand Cd
Colby fine sandy loam Cm
Cm Broken phase
Colby very fine sandy loam Cv
Cv Broken phase
Colby silt loam C
C Broken phase
Gannett loamy sand Gl
Hall fine sandy loam Hf
Hall very fine sandy loam Hl
Hall silt loam Hm
Hall silty clay loam Ha
Holdrege fine sandy loam Ho
Holdrege very fine sandy loam Hv
Hv Colluvial phase
Holdrege silt loam H
H Colluvial phase
Lamoure very fine sandy loam Lv
O'Neill loamy sand Os
O'Neill fine sandy loam Of
O'Neill very fine sandy loam Ov
Sarpy sand Ss
Scott silty clay loam Sc
Sioux fine sandy loam Sf
Valentine sand Vd
Valentine loamy sand Vs
Valentine fine sandy loam Vf
Dune sand D
CONVENTIONAL SIGNS
CULTURE
(Printed in black)
Intermittent streams
Springs, Canals and Ditches, Flumes
The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.
R. 25 W.
R. 24 W.
R. 21 W.
R. 17 W.
100°15′
99°15′
CUSTER CO.
LINCOLN CO.
DAWSON CO.
BUFFALO CO.
BOUNDARY LINE
SHERMAN CO.
T. 16 N.
T. 15 N.
T. 14 N.

Thomas D. Rice, Inspector, District 3.
Soils surveyed by F. A. Hayes, in charge, and M. H. Layton, U. S. Department of Agriculture and E. A. Nieschmidt, C. H. Hayes, A. N. Huddleston and S. S. Diedrichs, Nebraska Soil Survey.

Scale 1 inch - 1 mile

1 ½ 0 1 2 3 4 Miles

A. Hoen & Co., Inc., Balto.

Field Operations
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1926